

CRC

**HANDBOOK**  
*of tables for*  
**ORGANIC  
COMPOUND  
IDENTIFICATION**

3<sup>RD</sup> Edition

Zvi Rappoport

CRC PRESS



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1963

Zvi Rappaport



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Third Edition

Compiled by  
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**Tables for Identification of Organic Compounds**

Compiled by  
**Max Frankel, Ph.D.**  
**Saul Patai, Ph.D.**

Assisted by  
**Albert Zikha, Ph.D.**  
**Robert Farkas—Kadmon**

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**Tables for Identification of Organic Compounds**

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## PREFACE

The present volume is a revised and enlarged third edition of the book formerly titled TABLES FOR IDENTIFICATION OF ORGANIC COMPOUNDS. Four new classes of compounds, i.e., sulfonyl chlorides, sulfonamides, thiols and thioethers were added, bringing the number of classes included in the book to twenty-six. The tables of alkanes, alkenes, alkynes, aromatic hydrocarbons, phenols, nitriles and sulfonic acids were all thoroughly revised and considerably enlarged. In all, the addition of 2400 compounds to the third edition, raised the total number of parent compounds in the book to over 8150.

Three tables containing the dissociation constants of more than 1050 phenols, organic acids and organic bases were added. Correlation charts for I.R., Far I.R. and N.M.R. were also included.

Explanatory sections entitled "Explanations and References" precede the tables. In these sections the formulas of the derivatives and the full reaction equations for their preparation by the most important methods, together with some essential details and references to their preparations, are given.

An index covering both the names and synonyms of the compounds was added at the end of the book. An index listing the names of all tables and major subjects was also added.

The main objective of this book is to assist chemists in the identification of organic compounds. The organization of the compounds in classes according to increasing boiling points should also assist in the search for standard vapor phase chromatography work.

For further information of techniques of organic analysis one or more of the following books should be consulted:

- N. D. Cheronis, J. B. Entrikin and E. M. Hodnett, *Semimicro Qualitative Organic Analysis*, 3rd Ed., Interscience Publishers, New York, 1965.
- L. Meites, *Handbook of Analytical Chemistry*, McGraw Hill Book Co., 1963.
- F. Feigl, *Spot Tests in Organic Analysis*, 6th Ed., Elsevier Publishing Co., 1960.
- A. I. Vogel, *A Textbook of Practical Organic Chemistry*, 3rd Ed., Longmans Green and Co., London, 1957.
- R. L. Shriner, R. C. Fuson and D. Y. Curtin, *The Systematic Identification of Organic Compounds*, 4th Ed., John Wiley and Sons, New York, 1956.
- F. Wild, *Characterization of Organic Compounds*, 2nd Ed., Cambridge University Press, 1958.

The publication of the third edition would not have been possible without the work of those involved in the preparation of the earlier editions. The editor is thankful for the part in the earlier work contributed by Professors M. Frankel, S. Patai and A. Zilkha, and the late Mr. R. Farkas-Kadmon. Thanks are due also to Mrs. E. Shohamy and Mr. A. Glazer for assisting in collection of new data, to Mrs. Y. Elmaleh for typing the index, and especially to Prof. S. Patai, who as consulting editor, read all the new material and gave many helpful suggestions. The cooperation of Dr. Robert C. Weast and Mrs. F. Thomas in the publication of the book is gratefully acknowledged.

Z. R.

Jerusalem  
January 1967



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## LIST OF ABBREVIATIONS USED

[ $\alpha$ ] <sub>D</sub>	specific rotation	fum	fuming	pr	prisms
a	acid	glac	glacial	purp	purple
abs	absolute	glit	glittering	pyr	pyridine
abt	about	glyc	glycerol	rac	racemic (or racemate)
ac a	acetic acid	gran	granular	rect	rectangular
ac anh	acetic anhydride	grn	green	recr	recrystallization
acet	acetone	h	hot	redsh	reddish
add	addition	htng	heating	rhomb	rhombic
al	alcohol	hyd	hydrate or hydrolyses	r	rapid
alk	alkali	hyg, hydr	hygroscopic	r h	rapid heating
amor	amorphous	i	inactive	s	soluble
anh	anhydrous	i	insoluble	sec	secondary
arom	aromatic	ign	ignites	scar	scarcely
aqu	aqueous	insol	insoluble	s h	slow heating
asym, as	asymmetric	l, L	levorotatory (or L-configuration)	sh	short
bl	blue	leaf, lf	leaflets	sl	slightly
blk	black	lg	large	sld	solid
boil	boiling	lgr	ligroin	slend	slender
b p, B P	boiling point	liq	liquid	sm	small
br	brown	lng	long	soft	softens
bz	benzene	lt	light	sol, soln	solution(s)
brt	bright	lvs	leaves	solv	solvent(s)
brnsh	brownish	m-	meta	st	steel
c	cold	me, meth	methyl	stab	stable
ca	about	micr	microscopic	subl	sublimes
caust	caustic	mixt	mixture	sym	symmetrical
chl	chloroform	ml	milliliter	tab, tabl	tablet(s), tables
cl-bz	chlorobenzene	mod	modification	tert	tertiary
col	colorless	monohyd	monohydrate	tetr	tetragonal
comp	compound	monocl	monoclinic	tol	toluene
conc	concentrated	m p, M P	melting point	trans	transparent
cor	corrected	need, nd	needles	thk	thick
cr, cryst	crystals	o-	ortho	tricl	trichinic
d	decomposes	ol	olive	trim	trimeric
d, D	dextrorotatory (or D-configuration)	or	orange	uns	unsymmetrical
deriv	derivative	ord	ordinary	unst	unstable
deliq	deliquescent	org	organic	vac	vacuum, in vacuo
dil	dilute	orth	orthorhombic	v	very
dist	distillate	oxid	oxidation	var	variable
dk	dark	p-	para	vic-	vicinal
dl, d,l, D,L	racemic	pa	pale	visc	viscous
efflor	efflorescent	part	partly	volat	volatile or volatilizes
et	ethyl	pet	petroleum	vlt	violet
et ac	ethyl acetate	pet eth	petroleum ether	w	water
eth	ether	ph	phenyl	wh	white
exp	explodes	ph hydrz	phenyl hydrazine	yel	yellow
f	from	PhNO <sub>2</sub>	nitrobenzene	yelsh, ylsh	yellowish
fl	flakes	pl	plates	>	above, greater than
fluores	fluorescent	powd	powder	<	below, smaller than
f p	freezing point			∞	miscible
frz	freezes			xyl	xylene

## EXPLANATIONS AND REFERENCES TO THE TABLES

The following section gives explanations and references for the preparation of the derivatives appearing in the Tables. Formulas of the derivatives as well as the main methods for their preparation are given. Usually, only the reagents and the solvents required for the preparation of a derivative are mentioned without specific details for the reaction conditions and the exact procedure. The aim of these notes is mainly to enable the worker to choose the method preferable in the conditions and the reagents available to him in his laboratory for the derivatization of his specific compound. However, THIS IS ONLY A REFERENCE SECTION AND NOT AN INSTRUCTION MANUAL AND THE QUOTED REFERENCES SHOULD BE CONSULTED FOR THE ACTUAL PREPARATION OF DERIVATIVES, ESPECIALLY REGARDING SAFETY HAZARDS INVOLVED IN THE WORK.

References are usually given for the preparation of all the derivatives having separate columns in the Tables, as well as for important ones listed in the "miscellaneous" section of the Tables. References to five different popular analytical textbooks are given, assuming that at least one of them, or another equivalent publication, would be available to the worker. These are:

N. D. Cheronis, J. B. Entrikin and E. M. Hodnett, *Semimicro Qualitative Organic Analysis*, 3rd edition, Interscience, New York, 1965, quoted in the text as "Cheronis."

R. P. Linstead and B. C. L. Weedon, *A Guide to Qualitative Organic Chemical Analysis*, Butterworth Scientific Publication, London, 1956, quoted in the text as "Linstead."

R. L. Shriner, R. C. Fuson and D. Y. Curtin, *The Systematic Identification of Organic Compounds*, 4th edition, John Wiley and Sons, New York, 1956, quoted in the text as "Shriner."

A. I. Vogel, *A Textbook of Practical Organic Chemistry*, 3rd edition, Longmans, Green and Co., London, 1957, quoted in the text as "Vogel."

F. Wild, *Characterization of Organic Compounds*, 2nd edition, Cambridge University Press, Cambridge, 1958, quoted in the text as "Wild."

In addition, leading references from the original literature are also given. Although the literature coverage is not complete (especially for the common derivatives) it was attempted to describe different methods, and to give as many references as possible to less common derivatives having limited scope. More references can be found in the textbooks mentioned above.

Derivatives appear either in a separate column or in the "miscellaneous" section in the Tables, where separate columns are usually given for derivatives which should be tried first, and for which enough data are available. Derivatives which should be tried as a second choice, or preferred derivatives for which not enough data are available appear in the "miscellaneous" section. The explanations and the references for the different derivatives are arranged usually in the same order as in the Tables. Occasionally, this order is changed in the explanatory notes in order to describe the derivatives in a logical order (e.g., in Table 17 the phenylurethane appears in a separate column, while the phenylhydantoin appears in the "miscellaneous" section in the "explanations and references" section the phenylhydantoin appears directly after the phenylurethane).

Derivatives which are followed by an asterisk are those recommended for first trial. Other derivatives should be tried after these.

Although "Ar" usually stands for monovalent aromatic group, we used it a few times in the following sections as a polyvalent aromatic residue. This was done only for demonstration purposes.



## EXPLANATIONS AND REFERENCES TO TABLE I

As a result of their inertness no general suitable derivative exists for alkanes and cycloalkanes. Characterization is based only on the physical constants given in the Table: melting and boiling points, index of refraction and density. Any laboratory text-book will give adequate directions for the determination of these constants.

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives.

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**TABLE I. ALKANES AND CYCLOALKANES**  
**a) Gases and Liquids (Listed in order of increasing b.p.)\*\*\***

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$
1	Methane	-161.49	-182.48 <sup>T</sup>		
2	Ethane	-88.63	-183.27 <sup>T</sup>		
3	Propane	-42.07	-187.69 <sup>T</sup>		0.5005 <sup>S</sup>
4	Cyclopropane	-32.86	-127.42		0.720-79
5	2-Methylpropane (Isobutane)	-11.73	-159.6		0.5572 <sup>S</sup>
6	<i>n</i> -Butane	-0.50	-138.35	1.3326 <sup>S</sup>	0.5788 <sup>S</sup>
7	2,2-Dimethylpropane (Neopentane)	9.503	-16.55	1.342 <sup>S</sup>	0.5910 <sup>S</sup>
8	Cyclobutane	13.08 <sup>741</sup> , 12.5	-80	1.37520 <sup>0</sup>	0.7038 <sup>0</sup>
9	1,1-Dimethylcyclopropane	20.63	-108.96	1.3668	0.6589
10	2-Methylbutane	27.852	-159.9	1.35373	0.61967
11	<i>trans</i> -1,2-Dimethylcyclopropane	29		1.3713	0.6769
12	Ethylcyclopropane	35.94	-149.41	1.3786	0.6839
13	<i>n</i> -Pentane	36.074	-129.721	1.35748	0.62624
14	Methylcyclobutane	36.3		1.3830	0.6933
15	<i>cis</i> -1,2-Dimethylcyclopropane	37	-140.9	1.3822	0.6928
16	Spiropentane	38.977	-107.06	1.41200	0.755
17	Cyclopentane	49.262	-93.879	1.40645	0.74538
18	2,2-Dimethylbutane	49.741	-99.87	1.36876	0.64916
19	1,1,2-Trimethylcyclopropane	56.7 <sup>750</sup>		1.3848 <sup>19 S</sup>	0.6822 <sup>19 S</sup>
20	2,3-Dimethylbutane	57.988	-128.538	1.37495	0.66164
21	2-Methylpentane	60.271	-153.67	1.37145	0.65315
22	3-Methylpentane	63.282		1.37652	0.66431
23	1,2,3-Trimethylcyclopropane	65.7 <sup>755</sup>		1.3945 <sup>18</sup>	0.6946 <sup>18</sup>
24	<i>n</i> -Hexane	68.74	-95.348	1.37486	0.65937
25	Ethylcyclobutane	70.64	-142.85	1.4020	0.7280
26	Methylcyclopentane	71.812	-142.455	1.4097	0.74864
27	2,2-Dimethylpentane	79.197	-123.811	1.38215	0.67385
28	2,4-Dimethylpentane	80.5	-119.242	1.38145	0.67270
29	Cyclohexane	80.738	6.554	1.42623	0.77855
30	2,2,3-Trimethylbutane	80.882	-24.912	1.38944	0.69011
31	3,3-Dimethylpentane	86.064	-134.46	1.39092	0.69327
32	1,1-Dimethylcyclopentane	87.846	-69.795	1.41356	0.75448
33	2,3-Dimethylpentane	89.784		1.39196	0.69508
34	2-Methylhexane	90.052	-118.276	1.38485	0.67859
35	<i>trans</i> -1,3-Dimethylcyclopentane	90.773	-133.702	1.40894	0.74479
36	<i>cis</i> -1,3-Dimethylcyclopentane	91.725	-133.975	1.41074	0.74880
37	3-Methylhexane	91.850		1.38864	0.68713
38	<i>trans</i> -1,2-Dimethylcyclopentane	91.869	-117.58	1.41200	0.75144
39	3-Ethylpentane	93.475	-118.604	1.39339	0.69816
40	Quadracyclane (Quadricyclo [2,2,1,0 <sup>2</sup> ,0 <sup>3</sup> ,5] heptane)	98		1.4804	
41	<i>n</i> -Heptane	98.427	-90.61	1.38764	0.68376
42	2,2,4-Trimethylpentane	99.238	-107.38	1.39145	0.69192
43	<i>cis</i> -1,2-Dimethylcyclopentane	99.532	-53.892	1.42217	0.77262
44	Methylcyclohexane	100.934	-126.593	1.42312	0.76939
45	Ethylcyclopentane	103.466	-138.446	1.41981	0.76647
46	1,1,3-Trimethylcyclopentane	104.893	-142.44	1.41119	0.74825
47	2,2-Dimethylhexane	106.84	-121.18	1.39349	0.69528
48	2,5-Dimethylhexane	109.103	-91.20	1.39246	0.69354
49	1, <i>trans</i> -2, <i>cis</i> -4-Trimethylcyclopentane	109.29	-130.78	1.41060	0.74727
50	2,4-Dimethylhexane	109.429		1.39534	0.70036
51	2,2,3-Trimethylpentane	109.841	-112.27	1.40295	0.71602
52	1, <i>trans</i> -2, <i>cis</i> -3-Trimethylcyclopentane	110.2	-112.705	1.4138	0.7535
53	3,3-Dimethylhexane	111.969	-126.1	1.40009	0.7100
54	2,3,4-Trimethylpentane	113.467	-109.21	1.40422	0.71906
55	1,1,2-Trimethylcyclopentane	113.729	-21.64	1.42298	0.77252
56	2,3,3-Trimethylpentane	114.76	-100.70	1.40750	0.72619
57	2,3-Dimethylhexane	115.607		1.40113	0.71214
58	3-Ethyl-2-methylpentane	115.65	-114.96	1.40401	0.71932

\*Derivative data given in order m p, crystal color, solvent from which crystallized  
 \*\*T = triple point, S = at saturation pressure



**TABLE I. ALKANES AND CYCLOALKANES**  
**a) Gases and Liquids (Listed in order of increasing b.p.\*) (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>
59	1, <i>cis</i> -2, <i>trans</i> -4-Trimethylcyclopentane	116 731	-132 55	1 41855	0 76345
60	1, <i>cis</i> -2, <i>trans</i> -3-Trimethylcyclopentane	117 5	-112	1 4218	0 7704
61	2-Methylheptane	117 647	-109 04	1 39494	0 69792
62	4-Methylheptane	117 709	-120 955	1 39792	0 70463
63	3,4-Dimethylhexane	117 725		1 40406	0 71923
64	1, <i>cis</i> -2, <i>cis</i> -4-Trimethylcyclopentane	118		1 422	0 766
65	3-Ethyl-3-methylpentane	118 259	-90 87	1 40775	0 72742
66	3-Ethylhexane	118 534		1 40162	0 71358
67	3-Methylheptane	118 925	-120 5	1 39848	0 70582
68	Cycloheptane (Suberane)	118 20	-7 98	1 4449	0 8275 <sup>o</sup>
69	<i>trans</i> -1,4-Dimethylcyclohexane	119 351	-36 962	1 42090	0 76255
70	1,1-Dimethylcyclohexane	119 543	-33 495	1 42900	0 78094
71	<i>cis</i> -1,3-Dimethylcyclohexane	120 088	-75 573	1 42294	0 76603
72	<i>trans</i> -1-Ethyl-3-methylcyclopentane	120 8	-108	1 4186	0 7619
73	<i>trans</i> -1-Ethyl-2-methylcyclopentane	121 2		1 4219	0 7690
74	<i>cis</i> -1-Ethyl-3-methylcyclopentane	121 4		1 4203	0 7724
75	1-Ethyl-1-methylcyclopentane	121 522	-143 80	1 42718	0 78093
76	2,2,4,4-Tetramethylpentane	122 284	-66 54	1 40694	0 71947
77	1, <i>cis</i> -2, <i>cis</i> -3-Trimethylcyclopentane	123 0	-116 43	1 4262	0 7792
78	<i>trans</i> -1,2-Dimethylcyclohexane	123 419	-88 194	1 42695	0 77601
79	2,2,5-Trimethylhexane	124 084	-105 78	1 39972	0 70721
80	<i>cis</i> -1,4-Dimethylcyclohexane	124 321	-87 436	1 42966	0 78285
81	<i>trans</i> -1,3-Dimethylcyclohexane	124 45	-90 108	1 43085	0 78472
82	<i>n</i> -Octane	125 665	-56 795	1 39743	0 70252
83	Isopropylcyclopentane	126 419	-111 375	1 42582	0 77653
84	2,2,4-Trimethylhexane	126 54	-120	1 4033	0 7156
85	<i>cis</i> -1-Ethyl-2-methylcyclopentane	128 050	-105 95	1 42933	0 78522
86	<i>cis</i> -1,2-Dimethylcyclohexane	129 728	-50 023	1 43596	0 79627
87	2,4,4-Trimethylhexane	130 38	-113 38	1 40745	0 72381
88	<i>n</i> -Propylcyclopentane	130 8	-118 7	1 4266	0 7761
89	2,3,5-Trimethylhexane	131 34	-127 8	1 4061	0 7219
90	Ethylcyclohexane	131 783	-111 323	1 43304	0 78792
91	2,2-Dimethylheptane	132 69	-113 0	1 4016	0 7105
92	2,2,3,4-Tetramethylpentane	133 016	-121 09	1 41472	0 73895
93	2,4-Dimethylheptane	133 5		1 4033	0 716
94	Methylcycloheptane	133 5		1 4410	0 8052
95	2,2,3-Trimethylhexane	133 6		1 4105	0 7292
96	4-Ethyl-2-methylhexane	133 8		1 4068	0 723
97	3-Ethyl-2,2-dimethylpentane	133 83	-99 2	1 4123	0 7348
98	4,4-Dimethylheptane	135 2		1 4076	0 725
99	2,6-Dimethylheptane	135 21	-102 9	1 4007	0 7089
100	2,5-Dimethylheptane	136 0		1 4038	0 715
101	3,5-Dimethylheptane	136 0		1 4067	0 723
102	Bicyclo[4.2.0]octane	136 0		1 4613	0 8573
103	<i>cis</i> -Bicyclo[3.3.0]octane	136-6 5		1 4595 <sup>25</sup>	0 8638 <sup>25</sup>
104	2,4-Dimethyl-3-ethylpentane	136 73	-122 2	1 4137	0 7379
105	1,1,3-Trimethylcyclohexane	137-8		1 4362	0 7868 <sup>25</sup>
106	3,3-Dimethylheptane	137 3		1 4085	0 725
107	2,2,5,5-Tetramethylhexane	137 5		1 40550	0 71875
108	2,3,3-Trimethylhexane	137 68	-116 80	1 4141	0 738
109	3-Ethyl-2-methylhexane	138		1 4120	0 731
110	<i>trans</i> -1,3,5-Trimethylcyclohexane	138 5-9 <sup>754</sup>		1 42740 <sub>H</sub>	0 7720
111	2,3,4-Trimethylhexane	139 0		1 4144	0 7392
112	<i>cis</i> -1,3,5-Trimethylcyclohexane	140-0 5 <sup>752</sup>		1 43010 <sub>H</sub>	0 7773
113	<i>trans</i> -1,2,4-Trimethylcyclohexane	140-1		1 43121 <sub>He</sub>	0 7813
114	2,2,3,3-Tetramethylpentane	140 274	-9 9	1 42360	0 75666
115	4-Ethyl-3-methylhexane	140 4		1 416	0 742
116	3,3,4-Trimethylhexane	140 46	-101 2	1 4178	0 7454
117	2,3-Dimethylheptane	140 5		1 4085	0 7260

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE I. ALKANES AND CYCLOALKANES**  
**a) Gases and Liquids (Listed in order of increasing b.p. \*) (Continued)**

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$
118	3,4-Dimethylheptane	140.6		1.4111	0.7314
119	3-Ethyl-3-methylhexane	140.6		1.4142	0.741
120	4-Ethylheptane	141.2		1.4096	0.730
121	2,3,3,4-Tetramethylpentane	141.551	-102.123	1.42222	0.75473
122	2,3-Dimethyl-3-ethylpentane	142		1.419	0.754
123	<i>trans</i> -1,2,3-Trimethylcyclohexane	142.35 <sup>782</sup>		1.43582 <sub>He</sub>	0.7914
124	1-Isopropyl-3-methylcyclopentane (Pulegan)	142.4		1.4236	0.7730 <sup>22</sup>
125	4-Methyloctane	142.48	-113.2	1.4061	0.7199
126	1-Isopropyl-2-methylcyclopentane	142.5 <sup>759</sup>		1.4279	0.7792
127	3-Ethylheptane	143.0		1.4093	0.727
128	2-Methyloctane	143.26	-80.4	1.4031	0.7134
129	<i>cis</i> -1,2,3-Trimethylcyclohexane	144-6 <sup>753</sup>		1.43682 <sub>He</sub>	0.7930
130	3-Methyloctane	144.18	-107.6	1.4062	0.7207
131	2,4,6-Trimethylheptane	144.8		1.4071	0.7225
132	<i>cis</i> -1,2,4-Trimethylcyclohexane	146		1.43209	0.786
133	3,3-Diethylpentane	146.168	-33.11	1.42051	0.75359
134	2,2-Dimethyl-4-ethylhexane	147		1.4131	0.733
135	2,2,4-Trimethylheptane	147.7		1.4092	0.7275
136	2,2,4,5-Tetramethylhexane	147.8		1.41318	0.73546
137	2,2,5-Trimethylheptane	148		1.409	0.726
138	2,2,6-Trimethylheptane	148.2		1.4059	0.7195
139	2,2,3,5-Tetramethylhexane	148.4		1.4142	0.7378
140	Nopinane (7,7-Dimethylbicyclo[3.1.1]heptane)	149 <sup>747</sup>		1.4641	0.8611 <sup>22</sup>
141	<i>trans</i> -1-Ethyl-4-methylcyclohexane	149.05-15	-80.8	1.4304	0.7798
142	Cyclooctane	150 <sup>750</sup>	14(4.3)	1.4586	0.8349
143	1-Ethyl-2-methylcyclohexane	150.2		1.432	0.784
144	<i>n</i> -Nonane	150.81	-53.519	1.40542	0.71763
145	1,3,3-Trimethylbicyclo[2.2.1]heptane (Fenchane)	151.2		1.44714	0.8345
146	<i>trans</i> -1-Ethyl-4-methylcyclohexane	151.69		1.4382	0.7972
147	<i>cis</i> -1,1,3,5-Tetramethylcyclohexane	152.4-5		1.4319	0.7813
148	<i>cis</i> -1-Ethyl-4-methylcyclohexane	152.55-60		1.4374	0.7969
149	2,5,5-Trimethylheptane	152.8		1.4136	0.7368
150	2,4,4-Trimethylheptane	153		1.412	0.733
151	2,3,3,5-Tetramethylhexane	153		1.4196	0.746
152	2,2,4,4-Tetramethylhexane	153.3		1.4208	0.7470
153	Isopropylcyclohexane	154.5	-89.8	1.44095	0.80232
154	1,1,3,3-Tetramethylcyclohexane	154.8-5.0		1.4374	0.7936
155	2,2,3,4-Tetramethylhexane	154.9		1.4226	0.7548
156	2,2-Dimethyloctane	155		1.4082	0.7245
157	3-Ethyl-2,4,4-trimethylpentane	155.3		1.4223	0.7571
158	3,3,5-Trimethylheptane	155.6		1.4170	0.7428
159	2,3,6-Trimethylheptane	155.7		1.4125	0.7345
160	2,4-Dimethyloctane	155.8-6.0		1.4090	0.7259 <sup>20</sup>
161	<i>d,l-cis</i> -1-Ethyl-3-methylcyclohexane	155.97		1.4432	0.8094
162	<i>d,l</i> -2,5-Dimethyloctane	156-8		1.4160	0.7370
163	1,1,3,5-Tetramethylcyclohexane	156.4-5		1.4370	0.7929
164	<i>n</i> -Butylcyclopentane	156.56	-107.985	1.4316	0.7846
165	<i>n</i> -Propylcyclohexane	156.724	-94.90	1.43705	0.79360
166	2,3,5-Trimethylheptane	157		1.416	0.741
167	2,5-Dimethyl-3-ethylhexane	157		1.416	0.741
168	2,4,5-Trimethylheptane	157		1.4160	0.741
169	2,4-Dimethyl-3-isopropylpentane	157		1.42463	0.75830
170	2,2,3-Trimethylheptane	158		1.417	0.7420
171	2,4-Dimethyl-4-ethylhexane	158		1.419	0.747
172	2,2-Dimethyl-3-ethylhexane	159		1.420	0.749
173	2,2,3,4,4-Pentamethylpentane	159.3		1.43069	0.76703
174	1,1,3,4-Tetramethylcyclohexane	159.5-6.1		1.4380	0.7976
175	5-Ethyl-2-methylheptane	159.7		1.4134	0.736
176	2,7-Dimethyloctane	159.9		1.4086	0.7242

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE I. ALKANES AND CYCLOALKANES  
a) Gases and Liquids (Listed in order of increasing b.p.\*) (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4$
177	3,6-Dimethyloctane	160		1.4145 <sup>18</sup>	0.7363
178	3,5-Dimethyloctane	160		1.413	0.736
179	4-Isopropylheptane	160		1.417	0.741
180	2,3,3-Trimethylheptane	160		1.4202	0.7488
181	4-Ethyl-2-methylheptane	160		1.413	0.736
182	2,6-Dimethyloctane	160-0.5		1.4113	0.7285
183	2,2,3,3-Tetramethylhexane	160.3		1.42818	0.76446
184	<i>trans</i> -1-Isopropyl-4-methylcyclohexane ( <i>p</i> -Menthane)	161		1.4393	0.792
185	4,4-Dimethyloctane	161		1.4144	0.7347
186	2,3,4,5-Tetramethylhexane	161		1.424	0.757
187	5-Ethyl-3-methylheptane	161		1.414	0.737
188	3,3-Dimethyloctane	161.2		1.4165	0.7390
189	4,5-Dimethyloctane	162		1.4173	0.7458
190	3,4-Diethylhexane	162		1.420	0.754
191	4-Propylheptane	162		1.4150	0.7364
192	1,1,4-Trimethylcycloheptane (Eucarvane)	162.3 <sup>720</sup>		1.4420	0.8011
193	<i>trans</i> -1,2,3,5-Tetramethylcyclohexane	162.4		1.44657 <sup>He</sup>	0.8140
194	2,3,4,4-Tetramethylhexane	162.2		1.4270	0.7639
195	2,3,4-Trimethylheptane	163		1.421	0.751
196	3-Isopropyl-2-methylhexane	163		1.421	0.751
197	2,2,7-Trimethylbicyclo[2.2.1]heptane ( $\alpha$ -Fenchane)	163.5.4.5 <sup>753</sup>		1.4590	0.8579
198	3-Ethyl-3-methylheptane	163.8		1.4208	0.7501
199	2,4-Dimethyl-3-ethylhexane	164		1.424	0.759
200	3,4,4-Trimethylheptane	164		1.424	0.757
201	3,3,4-Trimethylheptane	164		1.424	0.757
202	3,4,5-Trimethylheptane	164		1.424	0.759
203	2,3-Dimethyl-4-ethylhexane	164		1.424	0.759
204	1-Methyl-3-propylcyclohexane	164-5 (171.3)		1.4377	0.7895 <sup>21</sup>
205	2,3-Dimethyloctane	164.4.4.6 <sup>764</sup>		1.4152	0.7377
206	<i>d,l</i> -Pinane	164.5.5.0		1.4609	0.8551
207	2,3,3,4-Tetramethylhexane	164.6		1.4297	0.7694
208	3,3-Dimethyl-4-ethylhexane	165		1.427	0.764
209	5-Methylnonane	165.1	-87.7	1.4122	0.7326
210	4-Methylnonane	165.7	-98.7	1.4123	0.7323
211	3-Ethyl-2-methylheptane	166		1.418	0.746
212	3,4-Dimethyloctane	166		1.4182	0.746
213	<i>d</i> - $\alpha$ -Pinane	166.6.5 <sup>762</sup>		1.4630	0.8560
214	<i>d,l</i> -1-Isopropyl-3-methylcyclohexane ( <i>d,l</i> - <i>m</i> -Menthane)	166.7		1.44 <sup>24</sup>	0.7965 <sup>24</sup>
215	2,2,3,3,4-Pentamethylpentane	166.1		1.43606	0.78009
216	<i>trans</i> -1,2,4,5-Tetramethylcyclohexane	166.2-8.0		1.44446 <sup>He</sup>	0.8100
217	3,3-Diethylhexane	166.3		1.428	0.767
218	2-Methylnonane	166.8	-74.5	1.4099	0.7281
219	<i>d</i> -1-Isopropyl-3-methylcyclohexane ( <i>d</i> - <i>m</i> -Menthane)	167		1.446 <sup>23</sup>	0.8116 <sup>23</sup>
220	3-Ethyl-4-methylheptane	167		1.422	0.753
221	4-Ethyl-3-methylheptane	167		1.422	0.753
222	4-Ethyl-4-methylheptane	167		1.421	0.752
223	1- $\beta$ -Pinane	167.5-8 <sup>748</sup>		1.4605	0.8567
224	3-Methylnonane	167.8	-84.8	1.4125	0.7334
225	3-Ethylheptane	168		1.416	0.740
226	4-Ethylheptane	168		1.416	0.740
227	3-Ethyl-2,2,3-trimethylpentane	168		1.436	0.781
228	1-1-Isopropyl-3-methylcyclohexane ( <i>l</i> - <i>m</i> -Menthane)	168		1.4358	0.7938
229	<i>cis</i> -1-Isopropyl-4-methylcyclohexane ( <i>cis</i> - <i>p</i> -Menthane)	168.5		1.4515	0.816
230	<i>cis</i> -1,2,3,5-Tetramethylcyclohexane	168-70 <sup>762</sup>		1.44847 <sup>He</sup>	0.8166
231	2,3-Dimethyl-3-ethylhexane	169		1.427	0.765

\*Derivative data given in order m p, crystal color solvent from which crystallized

**TABLE I. ALKANES AND CYCLOALKANES**  
**a) Gases and Liquids (Listed in order of increasing b.p.\*) (Continued)**

No	Name		Boiling point, °C	$n_D^{20}$	$D_4^{20}$
232	1-Isopropyl-4-methylcyclohexane ( <i>p</i> -Menthane)	169 70		1 4375 <sup>41</sup>	0 7929
233	3,4-Dimethyl-3-ethylhexane	170		1 431	0 772
234	3,3,4,4-Tetramethylhexane	170		1 4368	0 7824
235	Cyclononane	170-2	9 7	1 4328 <sup>16</sup>	0 8534 <sup>15 2</sup>
236	1-Isopropyl-2-methylcyclohexane ( <i>o</i> -Menthane)	171		1 447 <sup>21</sup>	0 8135 <sup>21</sup>
237	<i>cis</i> -1,2,4,5-Tetramethylcyclohexane	171 <sup>755</sup>		1 44647 <sup>He</sup>	0 8122
238	1-Methyl-1-propylcyclohexane	172		1 4440	0 8101
239	<i>n</i> -Decane	174 123	-29 661	1 41189	0 73005
240	1-Methyl-4-propylcyclohexane	174 3-7 1		1 4393	0 798
241	1-Methyl-2-propylcyclohexane	175 5 6 0 <sup>7 6</sup>		1 4468 <sup>19</sup>	0 8130 <sup>19</sup>
242	<i>n</i> -Pentylcyclopentane	180 60 <sup>10</sup>	-83	1 4358	0 7912
243	<i>n</i> -Butylcyclohexane	180 947	-74 725	1 44075	0 79918
244	<i>trans</i> -Decahydronaphthalene ( <i>trans</i> -Decalin)	187 25	-30 40	1 4695	0 8699
245	Isoamylcyclohexane	193		1 4423	0 8023
246	<i>cis</i> -Decahydronaphthalene ( <i>cis</i> -Decalin)	195 69	-43 01	1 4810	0 8965
247	<i>n</i> -Undecane ( <i>n</i> Hendecane)	195 89	-25 594	1 41716	0 74017
248	Cyclodecane	201	9 6	1 4692	0 8577 <sup>20 4</sup>
249	<i>n</i> -Pentylcyclohexane	202 8	-57 5	1 4437	0 8037
250	<i>n</i> -Hexylcyclopentane	203		1 4392	0 7965
251	9-Methyl- <i>trans</i> -decahydronaphthalene	205, 77 <sup>10</sup>		1 4631	0 8620
252	1,10-Dimethyl- <i>trans</i> -decahydronaphthalene	213 83 <sup>10</sup>		1 4659	0 8633
253	9-Methyl- <i>cis</i> -decahydronaphthalene	215 85 <sup>10</sup>		1 4804	0 8910
254	<i>n</i> -Dodecane	216 278, 51 84 <sup>1</sup>	-9 587 (-12)	1 42160	0 74869
255	1,10-Dimethyl- <i>cis</i> -decahydronaphthalene	220, 88 99 <sup>10</sup>		1 4812	0 8896
256	<i>n</i> -Hexylcyclohexane	224 0, 92 0 <sup>10</sup>	-43	1 4462	0 8076
257	<i>n</i> -Heptylcyclopentane	224		1 4421	0 8010
258	9-Ethyl- <i>trans</i> -decahydronaphthalene	225 93 06 <sup>10</sup>		1 466	0 8610
259	9-Ethyl- <i>cis</i> -decahydronaphthalene	233 99 <sup>10</sup>		1 480	0 8860
260	1-Methyl- <i>trans</i> -decahydronaphthalene	235, 101 <sup>10</sup>		1 4270	
261	<i>n</i> -Tridecane	235 44 66 35 <sup>1</sup>	-5 392	1 4256	0 7564
262	Bicyclohexyl	236 5 7 5, 100 <sup>10</sup>	3 5-4 0	1 4795	0 8848
263	<i>n</i> -Octylcyclopentane	243		1 4446	0 8048
264	<i>n</i> -Heptylcyclohexane	244		1 4484	0 8109
265	<i>n</i> -Tetradecane	235 57, 80 13 <sup>1</sup>	5 863	1 4289	0 7628
266	<i>n</i> -Nonylcyclopentane	262		1 4467	0 8081
267	<i>n</i> -Octylcyclohexane	264		1 4503	0 8138
268	<i>n</i> -Pentadecane	270 63, 93 26 <sup>1</sup>	9 926	1 4319	0 7685
269	<i>n</i> -Decylcyclopentane	279 3		1 44862	0 81097
270	<i>n</i> -Nonylcyclohexane	282		1 4519	0 8163
271	<i>n</i> -Undecylcyclopentane ( <i>n</i> -Hendecylcyclopentane)	296		1 4503	0 8135
272	<i>n</i> -Decylcyclohexane	299		1 45338	0 81858
273	2-Methylheptadecane	311, 178 5 <sup>15</sup>		1 4394 <sup>14</sup>	0 7838 <sup>15</sup>
274	<i>n</i> -Dodecylcyclopentane	312		1 4518	0 8158
275	<i>n</i> -Undecylcyclohexane ( <i>n</i> -Hendecylcyclohexane)	316	5 8	1 4547	0 8206
276	<i>n</i> -Tridecylcyclopentane	327	5	1 4531	0 8178
277	<i>n</i> -Dodecylcyclohexane	331	12 5	1 4559	0 8223
278	<i>n</i> -Tetradecylcyclopentane	341	9	1 4543	0 8196

\*Derivative data given in order *m p*, crystal color, solvent from which crystallized



TABLE I. ALKANES AND CYCLOALKANES  
b) Solids (Listed in order of increasing m.p.)\*\*\*

No.	Name	Melting point, °C	Boiling point, °C	$n_D$	$D_4$
1	Pentadecylcyclopentane	17	355	1.4554 <sup>20</sup>	0.8213 <sup>20</sup>
2	<i>n</i> -Hexadecane (Cetane)	18.165	286.793; 105.20 <sup>1</sup>	1.43453 <sup>20</sup>	0.7734 <sup>20</sup>
3	Tridecylcyclohexane	18.5	346	1.4570 <sup>20</sup>	0.8239 <sup>20</sup>
4	Hexadecylcyclopentane	21	.....	1.4543 <sup>25</sup>	0.8194 <sup>25</sup>
5	<i>n</i> -Heptadecane	21.98	301.82; 117.26 <sup>1</sup>	1.4348 <sup>25</sup> ; 1.4369 <sup>20</sup>	0.7745 <sup>25</sup> ; 0.7780 <sup>20</sup>
6	Tetradecylcyclohexane	24	.....	1.4559 <sup>25</sup>	0.8221 <sup>25</sup>
7	Heptadecylcyclopentane	27	.....	1.4532 <sup>30</sup>	0.8173 <sup>30</sup>
8	<i>n</i> -Octadecane	28.18	316.12; 128.28 <sup>1</sup>	1.4191 <sup>70</sup> ; 1.4390 <sup>20</sup>	0.7751 <sup>30</sup> ; 0.7819 <sup>20</sup>
9	Pentadecylcyclohexane	29	.....	1.4545 <sup>30</sup>	0.8201 <sup>30</sup>
10	Octadecylcyclopentane	30	.....	1.4541 <sup>30</sup>	0.8186 <sup>30</sup>
11	<i>n</i> -Nonadecane	32.1	329.7; 138.8 <sup>1</sup>	1.4211 <sup>70</sup> ; 1.4409 <sup>20</sup>	0.7787 <sup>30</sup> ; 0.7855 <sup>20</sup>
12	Hexadecylcyclohexane	33.6	.....	1.4596 <sup>20</sup>	0.8279 <sup>20</sup>
13	Nonadecylcyclopentane	35	.....	1.4588 <sup>20</sup>	0.8266 <sup>20</sup>
14	<i>n</i> -Eicosane	36.8	342.7; 148.9 <sup>1</sup>	1.4230 <sup>70</sup> ; 1.4426 <sup>20</sup>	0.7550 <sup>70</sup> ; 0.7887 <sup>20</sup>
15	Heptadecylcyclohexane	37.8	.....	1.4603 <sup>20</sup>	0.8290 <sup>20</sup>
16	Eicosylcyclopentane	38	.....	1.4595 <sup>20</sup>	0.8276 <sup>20</sup>
17	<i>n</i> -Heneicosane	40.5	356.5; 152.94 <sup>1</sup>	1.4247 <sup>70</sup> ; 1.4441 <sup>20</sup>	0.7583 <sup>70</sup> ; 0.7917 <sup>20</sup>
18	Octadecylcyclohexane	41.6	.....	1.4610 <sup>20</sup>	0.8300 <sup>20</sup>
19	Heneicosylcyclopentane	42	.....	1.4602 <sup>20</sup>	0.8286 <sup>20</sup>
20	<i>n</i> -Docosane	44.4 (47)	368.6; 161.88 <sup>1</sup>	1.4260 <sup>70</sup> ; 1.4455 <sup>20</sup>	0.7631 <sup>70</sup> ; 0.8295 <sup>20</sup>
21	Docosylcyclopentane	45	.....	1.4608 <sup>20</sup>	0.8295 <sup>20</sup>
22	Nonadecylcyclohexane	45.2	.....	1.4616 <sup>20</sup>	0.8310 <sup>20</sup>
23	<i>n</i> -Tricosane	47.6	380.2; 170.48 <sup>1</sup>	1.4276 <sup>20</sup> ; 1.4468 <sup>20</sup>	0.7641 <sup>70</sup> ; 0.7969 <sup>20</sup>
24	Eicosylcyclohexane	48.5	.....	1.4622 <sup>20</sup>	0.8318 <sup>20</sup>
25	Tricosylcyclopentane	49	.....	1.4614 <sup>20</sup>	0.8304 <sup>20</sup>
26	<i>n</i> -Tetracosane	50.9	391.3; 178.7 <sup>1</sup>	1.4286 <sup>70</sup> ; 1.4480 <sup>20</sup>	0.7657 <sup>70</sup> ; 0.7991 <sup>20</sup>
27	Tetracosylcyclopentane	51	.....	1.4619 <sup>20</sup>	0.8312 <sup>20</sup>
28	Heneicosylcyclohexane	51.5	.....	1.4627 <sup>20</sup>	0.8326 <sup>20</sup>
29	<i>n</i> -Pentacosane	53.7	401.9; 186.55 <sup>1</sup>	1.4302 <sup>70</sup> ; 1.4491 <sup>20</sup>	0.7693 <sup>70</sup> ; 0.8012 <sup>20</sup>
30	Pentacosylcyclopentane	54	.....	1.4624 <sup>20</sup>	0.8319 <sup>20</sup>
31	Docosylcyclohexane	54.4	.....	1.4632 <sup>20</sup>	0.8334 <sup>20</sup>
32	Hexacosylcyclopentane	56	.....	1.4628 <sup>20</sup>	0.8326 <sup>20</sup>
33	Nortricyclene (Tricyclo[2.2.1.0 <sup>2,6</sup> ]heptane)	56	106-7	.....	.....
34	<i>n</i> -Hexacosane	56.4	412.2; 194.18 <sup>1</sup>	1.4310 <sup>70</sup> ; 1.4501 <sup>20</sup>	0.7704 <sup>70</sup> ; 0.8032 <sup>20</sup>
35	Cyclohexadecane	57	93-8 <sup>0,8</sup>	.....	.....
36	Tricosylcyclohexane	57	.....	1.4637 <sup>20</sup>	0.8341 <sup>20</sup>
37	Heptacosylcyclopentane	59	.....	1.4633 <sup>20</sup>	0.8333 <sup>20</sup>
38	<i>n</i> -Heptacosane	59.0	422.1; 201.54 <sup>1</sup>	1.4321 <sup>70</sup> ; 1.4511 <sup>20</sup>	0.7732 <sup>70</sup> ; 0.8050 <sup>20</sup>
39	Tetracosylcyclohexane	59.5	.....	1.4641 <sup>20</sup>	0.8347 <sup>20</sup>
40	Cyclopentadecane	60-1	.....	1.4592 <sup>61,5</sup>	0.8634 <sup>61,5</sup>
41	Octacosylcyclopentane	61	.....	1.4637 <sup>20</sup>	0.8339 <sup>20</sup>
42	<i>n</i> -Octacosane	61.4	431.6; 208.58 <sup>1</sup>	1.4330 <sup>70</sup> ; 1.4520 <sup>20</sup>	0.7750 <sup>70</sup> ; 0.8067 <sup>20</sup>
43	Pentacosylcyclohexane	61.9	.....	1.4645 <sup>20</sup>	0.8353 <sup>20</sup>
44	Nonacosylcyclopentane	63	.....	1.4640 <sup>20</sup>	0.8345 <sup>20</sup>
45	<i>n</i> -Nonacosane	63.7	440.8; 172.36 <sup>0,1</sup>	0.7797 <sup>65</sup> ; 1.4529 <sup>20</sup>	1.4361 <sup>65</sup> ; 0.8083 <sup>20</sup>

\*Derivative data given in order: m.p., crystal color, solvent from which crystallized.

\*\*U = undercooled liquid.

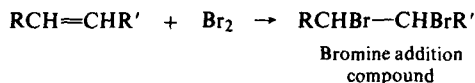
**TABLE I. ALKANES AND CYCLOALKANES**  
**b) Solids (Listed in order of increasing m.p.)\*\*\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	$n_D$	$D_4$
46	Hexacosylcyclohexane	64		1.4649 <sup>U</sup>	0.8359 <sup>U</sup>
47	Triacosylcyclopentane	65		1.4644 <sup>U</sup>	0.8350 <sup>U</sup>
48	<i>d,l</i> -Isobornane (2,2,3-Trimethylbicyclo[2.2.1]heptane)	65-7		1.44186 <sup>67</sup>	0.82757 <sup>67</sup>
49	<i>n</i> -Triacontane	65.8	449.7, 222.00 <sup>1</sup>	1.4348 <sup>70</sup> , 1.4536 <sup>U</sup>	0.7797 <sup>70</sup> , 0.8097 <sup>U</sup>
50	Heptacosylcyclohexane	66.1		1.4653 <sup>U</sup>	0.8365 <sup>U</sup>
51	Hentriacontylcyclopentane	67		1.4648 <sup>U</sup>	0.8356 <sup>U</sup>
52	<i>n</i> -Hentriacontane	67.9	458, 184.17 <sup>0.1</sup>	1.4543 <sup>U</sup>	0.8111 <sup>U</sup>
53	Octacosylcyclohexane	68		1.4656 <sup>U</sup>	0.8370 <sup>U</sup>
54	Dotriacontylcyclopentane	69		1.4651 <sup>U</sup>	0.8360 <sup>U</sup>
55	<i>n</i> -Dotriacontane (Bicetyl)	69.7	467, 234.8 <sup>1</sup>	1.4550 <sup>U</sup>	0.7791 <sup>75</sup> , 0.8124 <sup>U</sup>
56	Nonacosylcyclohexane	69.9		1.4659 <sup>U</sup>	0.8374 <sup>U</sup>
57	Trtriacontylcyclopentane	70		1.4654 <sup>U</sup>	0.8365 <sup>U</sup>
58	Trtriacontane	71.4		1.4557 <sup>U</sup>	0.8136 <sup>U</sup>
59	Triacosylcyclohexane	71.6		1.4662 <sup>U</sup>	0.8379 <sup>U</sup>
60	Tetatriacontylcyclopentane	72		1.4657 <sup>U</sup>	0.8370 <sup>U</sup>
61	Tetatriacontane	72.6, 73.1	285.4 <sup>3</sup>	1.4296 <sup>90</sup> , 1.4563 <sup>U</sup>	0.7728 <sup>90</sup> , 0.8148 <sup>U</sup>
62	28-Methylnonacosane	73.4	222 <sup>0.3</sup>		
63	Hentriacontylcyclohexane	73.3		1.4665 <sup>U</sup>	0.8383 <sup>U</sup>
64	Pentatriacontylcyclopentane	74		1.4660 <sup>U</sup>	0.8374 <sup>U</sup>
65	Pentatriacontane	74.7	331	1.4568 <sup>U</sup>	0.8157 <sup>U</sup>
66	Dotriacontylcyclohexane	74.8		1.4668 <sup>U</sup>	0.8388 <sup>U</sup>
67	Hexatriacontylcyclopentane	75		1.4662 <sup>U</sup>	0.8378 <sup>U</sup>
68	Hexatriacontane	76.2		1.4573 <sup>U</sup>	0.8169 <sup>U</sup>
69	Trtriacontylcyclohexane	76.3		1.4670 <sup>U</sup>	0.8391 <sup>U</sup>
70	Heptatriacontane	77.7		1.4578 <sup>U</sup>	0.8179 <sup>U</sup>
71	Tetatriacontylcyclohexane	77.7		1.4673 <sup>U</sup>	0.8395 <sup>U</sup>
72	Octatriacontane	79		1.4583 <sup>U</sup>	0.8188 <sup>U</sup>
73	Pentatriacontylcyclohexane	79.1		1.4675 <sup>U</sup>	0.8399 <sup>U</sup>
74	Nonatriacontane	80.3		1.4588 <sup>U</sup>	0.8197 <sup>U</sup>
75	Hexatriacontylcyclohexane	80.4		1.4678 <sup>U</sup>	0.8402 <sup>U</sup>
76	Tetracontane	81.5		1.4593 <sup>U</sup>	0.8205 <sup>U</sup>
77	Norbornane (Bicyclo[2.2.1]heptane)	86-7, subl			
78	2,2,3,3-Tetramethylbutane	100.69	106.47	1.4695 <sup>20</sup>	0.8242 <sup>23</sup> <sub>solid</sub>
79	Bornane (Camphane)	158.9, subl			
80	Adamantane	268 (252.3)		1.568	1.07 <sub>solid</sub>

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

\*\*U = undercooled liquid

## EXPLANATIONS AND REFERENCES TO TABLE II

*Bromine addition compound.\**

From the alkene and bromine in carbon tetrachloride.

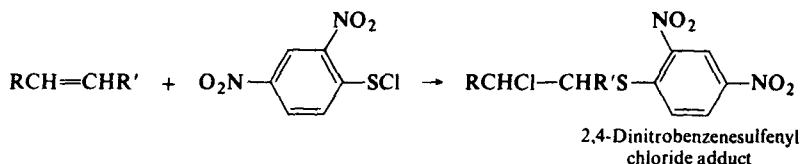
*For directions and examples see:* Cheronis, p. 576; Shriner, p. 106.

From the alkene and bromine in water.

*See:* Vogel, p. 241.

From the alkene and bromine in chloroform.

*See:* C. G. Schmitt and C. E. Boord, *J. Amer. Chem. Soc.*, **54**, 751 (1932).

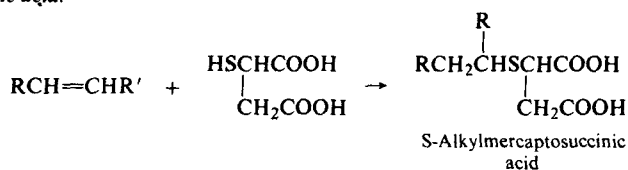
*2,4-Dinitrobenzenesulfonyl chloride addition compound.\**

From the alkene and 2,4-dinitrobenzenesulfonyl chloride in glacial acetic acid.

*For directions and examples see:* Cheronis, p. 577; N. Kharasch and C. M. Buess, *J. Amer. Chem. Soc.*, **71**, 2724 (1949); D. J. Cram, *J. Amer. Chem. Soc.*, **71**, 3883 (1949); N. Kharasch, C. M. Buess and S. I. Strashun, *J. Amer. Chem. Soc.*, **74**, 3422 (1952).

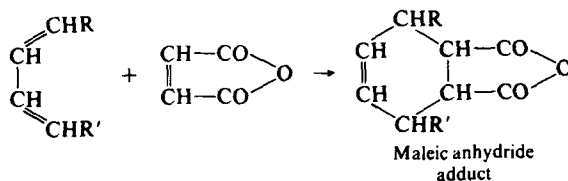
From the alkene and 2,4-dinitrobenzenesulfonyl chloride in benzene or in carbon tetrachloride.

*See:* N. Kharasch and C. M. Buess, *J. Amer. Chem. Soc.*, **71**, 2724 (1949).

*S-Alkylmercaptosuccinic acid.\**

From the alkene, mercaptosuccinic acid and benzoyl peroxide in methanol.

*For directions and examples see:* J. G. Hendrickson and L. F. Hatch, *J. Org. Chem.*, **25**, 1747 (1960).

*Maleic anhydride adduct (from dienes).*

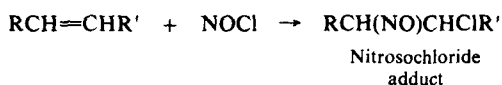
From the diene and maleic anhydride in benzene.

*For directions and examples see:* Linstead, p. 51; Vogel, p. 943.

From the diene and maleic anhydride in xylene.

*See:* Linstead, p. 51.

*For general references see:* M. C. Kloetzel in *Organic Reactions*, Vol. 4 (Ed. R. Adams), John Wiley and Sons, New York, 1948, p. 1; H. L. Holmes in *Organic Reactions*, Vol. 4, (Ed. R. Adams), John Wiley and Sons, New York, 1948, p. 60; O. Diels and K. Alder, *Chem. Ber.*, **62**, 2081 (1929).

*Nitrosochloride addition compound.*

**\*Derivatives recommended for first trial.**

**WARNING:** This is not an instruction manual. References should be consulted for the preparation of derivatives.

## EXPLANATIONS AND REFERENCES TO TABLE II (Continued)

From the alkene and nitrosyl chloride (prepared from sodium nitrite in concentrated hydrochloric acid) in ether-acetic acid mixture.

*For directions and examples see:* Linstead, p. 52; R. Perrot, *Compt. Rend.*, **203**, 329 (1936).

From the alkene and nitrosyl chloride (prepared from thionyl chloride and nitrogen trioxide) in ether.  
*See:* M. Tuot, *Compt. Rend.*, **204**, 697 (1937).

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.



TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)\*\*\*

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous
						x-Bromo-	B P, °C	M P, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	
1	Ethene (Ethylene)	-103.71	-169.15 <sup>T</sup>		0.384 <sup>u</sup>	di-	131.36	9.85	1.53868	2.1792	
2	Propene (Propylene)	-47.70	-185.25 <sup>T</sup>		0.5139	di-	141.99	-55.5	1.52004	1.93268	
3	Cyclopropene	-36 <sup>711</sup>									
4	Allene	-34.5	-136			tetra-		10.7	1.6200	2.703	
5	2-Methylpropene	-6.90	-140.35	1.3467	0.5942 <sup>S</sup>	di-	149		1.5080	1.7595	2,4-Dinitrophenyl-sulfonyl chloride, 86.7
6	1-Butene	-6.26	-185.35	1.3465	0.5951	di-	166.3		1.5150	1.7951	2,4-Dinitrophenyl-sulfonyl chloride, 77.5-8.5
7	1,3-Butadiene	-4.41	-108.92	1.4292 <sup>2</sup> 0.650 <sup>1</sup>	0.6255 <sup>1</sup>	tetra-		118 lgr			
8	trans-2-Butene	0.88	-105.55		0.6042 <sup>S</sup>	di-	161.0		1.5110	1.7852	
9	Cyclobutene	2.4			0.733 <sup>o</sup>						
10	cis-2-Butene	3.72	-138.91		0.6306 <sup>1</sup>	di-	161.0		1.5110	1.7852	
11	1,2-Butadiene (Methylallene)	10.85	-136.19	1.4208 <sup>1</sup>	0.652 <sup>S</sup>	tetra-	97.5	-2	1.6070	2.5085	
12	3-Methyl-1-butene	20.06	-168.49	1.3643	0.6272	di-	61.2 <sup>12</sup>		1.50932	1.6776	
13	1,4-Pentadiene	25.97	-148.28	1.38876	0.66706	tetra-		85.5-6.0, eth			
14	1-Pentene	29.97	-165.22	1.37148	0.64050	di-	68 <sup>12</sup>		1.5012 <sup>12</sup>	1.592 <sup>19</sup>	Mercaptosuccinic acid adduct, 107.3-6
15	2-Methyl-1-butene	31.16	-137.56	1.3778	0.6504	di-	47.4-48 <sup>9</sup>		1.5088	1.6711	Mercaptosuccinic acid adduct, 122.3-6
16	3-Methylcyclobutene	32		1.4005							
17	2-Methyl-1,3-butadiene (Isoprene)	34.07	-145.95	1.42194	0.68095	di-tetra-	90-6 <sup>12</sup> 155 60 <sup>12</sup>				Maleic anhyd adduct, 63-4, lgr
18	trans-2-Pentene	36.35	-140.24	1.3793	0.6482	di-	91.0 <sup>50</sup>		1.5096	1.6809	
19	cis-2-Pentene	36.94	-151.39	1.3830	0.6556	di-	92.4 <sup>50</sup>		1.5096	1.6817	
20	1-Methyl-1-cyclobutene	37.1		1.4088	0.7244						
21	2-Methyl-2-butene	38.57	-133.77	1.3874	0.6623						Nitroschloride, 74, Mercaptosuccinic acid adduct, 153.7-4.0
22	3-Methyl-1,2-butadiene (1,1-Dimethylallene)	40		1.410	0.680	tetra-	150.2 <sup>1</sup>		1.594 <sup>17</sup>	2.305 <sup>17</sup>	
23	Cyclopentadiene	40.83 <sup>2</sup>	-85	1.4398 <sup>19,5</sup>	0.7983 <sup>19</sup>						Dimer 32, Maleic anhyd adduct, 164.5 Benzoquinone adduct, 75.6
24	1,3-Pentadiene (Piperylene)	41.1	-88.9	1.4309	0.6803	tetra-		114.5, al			Maleic anhyd adduct, 61, pet eth, Oxid by KMnO <sub>4</sub> → HCOOH + CH <sub>3</sub> COOH
25	3,3-Dimethyl-1-butene	41.24	-115.2	1.3760	0.6529	di-	95.3 5.6 <sup>10</sup>		1.5109	1.5615	
26	1, trans-3-Pentadiene	42.03	-87.47	1.43008	0.67603	tetra-	131 <sup>3</sup>	115, al			
27	1, cis-3-Pentadiene	44.07	-140.82	1.43634	0.69102	tetra-	131 <sup>3</sup>	115, al			

\* Derivative data given in order m p, crystal color, solvent from which crystallized

\*\* T = triple point, S = at saturation pressure

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous
						x Bromo-	B P °C	M P °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	
28	Cyclopentene	44.24	-135.08	1.42246	0.77199	di-	71.5 <sup>12</sup>		1.5510 <sup>11</sup>	1.8713 <sup>11</sup>	Mercaptosuccinic acid adduct 142.8.3.1 Pseudo-nitrosite 69.70 Perbenzoic acid oxid → epoxy-cyclopentane b.p. 102.3
29	1,2-Pentadiene (Ethylallene)	44.86	-137.26	1.42091	0.69257	tetra-	94.6 <sup>9</sup>			2.3469 <sup>12</sup>	
30	2,3-Pentadiene (1,3-Dimethylallene)	48.27	-125.26	1.42842	0.69502						
31	4-Methyl-1-pentene	53.88	-153.63	1.3828	0.6642	di	87 <sup>21</sup>		1.4980	1.5689	Mercaptosuccinic acid adduct 102.6.9
32	3-Methyl-1-pentene	54.14	-153.0	1.3842	0.6675	di	99 <sup>10</sup>		1.5060	1.6016	
33	3-Methyl-1,4-pentadiene	55		1.405	0.695						
34	2,3-Dimethyl-1-butene	55.67	-157.27	1.3904	0.6779	di-	80 <sup>1</sup>		1.5105	1.6033	
35	2-Methyl-1,4-pentadiene	56		1.405	0.694						
36	4-Methyl-cis-2-pentene	56.3	-134.43	1.3880	0.6690	di	72.3 <sup>18</sup>		1.5060	1.5983	
37	4-Methyl-trans-2-pentene	58.55	-140.81	1.3889	0.6686	di-	78 <sup>22</sup>		1.5070	1.5996	
38	1,5-Hexadiene (Biallyl)	59.46	-140.8	1.4042	0.6923	tetra-		52			Dil. HNO <sub>3</sub> → succinic ac. 185
39	2-Methyl-1-pentene	60.7	-135.72	1.3920	0.6817	di	87.8 <sup>20</sup>		1.5015	1.5581	
40	1-Hexene	63.49	-139.82	1.38788	0.67317	di-	89.90 <sup>18</sup>		1.5024	1.5774	2,4-Dinitrophenyl-sulfonyl chloride 61.2 Mercaptosuccinic acid adduct, 94.5.5.7
41	2-Ethyl-1-butene	64.6	-131.53	1.3969	0.6894	di-	87 <sup>21</sup>		1.5112	1.6045	
42	trans-1,3-Hexadiene	64.5.5.5		1.4060 <sup>19</sup>	0.6925 <sup>19</sup>	tetra-		19			
43	3-Methylcyclopentene	65.0		1.4207	0.7622						
44	cis-3-Hexene	66.44	-137.82	1.3947	0.6796	di	80.1 <sup>13</sup>		1.5045	1.6027	
45	3-Hexene (cis-trans mixture)	66.6-67		1.3942	0.6816	di-	80.1 <sup>13</sup>		1.5045	1.6027	
46	trans-3-Hexene	67.08	-113.43	1.3943	0.6772	di-	80.1 <sup>13</sup>		1.5045	1.6027	
47	2-Methyl-2-pentene	67.29	-135.7	1.4004	0.6863	di-	71-2 <sup>18</sup>		1.5063	1.5849	Mercaptosuccinic acid adduct, 152.1.6
48	3-Methyl-trans-2-pentene	67.63	-134.84	1.4016	0.6942	di-	72.4 <sup>15</sup>		1.5085		
49	trans-2-Hexene	67.87	-132.97	1.3935	0.6784	di-	90 <sup>16</sup>		1.5025	1.5812	
50	2-Hexene (cis-trans mixture)	67.9.8.1		1.3928	0.6813	di-	90 <sup>16</sup>		1.5025	1.5812	
51	2,3-Hexadiene	68		1.395	0.680						
52	2,3-Dimethyl-1,3-butadiene	68.78	-76.01	1.4394	0.7267	di-		47, lgr 138, bz			Maleic anhyd. adduct, 78-9
53	cis-2-Hexene	68.84	-141.14	1.3977	0.6869	di-	90 <sup>16</sup>		1.5025	1.5812	
54	4-Methyl-1,2-pentadiene (1-Isopropylallene)	70		1.424	0.708						
55	3-Methyl-cis-2-pentene	70.45	-138.45	1.4045	0.6986	di-	72-4 <sup>15</sup>		1.5085		

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous	
						<i>α</i> -Bromo-	B P, °C	M P, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>		
56	2-Methyl-2,3-pentadiene (Trimethyl allene)	72		1 425	0 711							
57	1,4-Hexadiene	72 3 2 5		1 4402 <sup>19</sup>	0 7057 <sup>19</sup>	tetra- 2 forms		a) 63 4 b) f p <-50				
58	4,4-Dimethyl-1-pentene	72 49	-136 6	1 3918	0 6827	di	77-8 <sup>9</sup>		1 4970	1 5129		Mercaptosuccinic acid adduct, 119 0 5
59	1, (cis and/or trans)-3-hexadiene	73		1 438	0 705							
60	2,3-Dimethyl-2-butene	73 21	-74 28	1 4122	0 7080	di		173 4 121				
61	2-Ethyl-1,3-butadiene	75		1 445	0 717							
62	4-Methylcyclopentene	75 2		1 4306	0 7796							
63	1-Methylcyclopentene	75 8	-127	1 4330	0 7802							
64	2-Methyl-1, (cis and/or trans)-3-pentadiene	76		1 446	0 719							
65	1,2-Hexadiene (n-Propylallene)	76		1 4282	0 7149	tetra-	130 <sup>3</sup>		1 5850	2 1873		
66	2-Methyl-1, (cis and/or trans)-3-pentadiene	76		1 446	0 719							
67	4-Methyl-1,3-pentadiene	76 3		1 451	0 719							
68	4,4-Dimethyl-trans-2-pentene	76 75	-115 24	1 3982	0 6889	di-	92 8- 93 <sup>14</sup>		1 5080	1 5538		
69	3,3-Dimethyl-1-pentene	77 54	-134 3	1 3984	0 6974	di-	95 3 6 <sup>10</sup>		1 5109	1 5615		
70	2,3,3-Trimethyl-1-butene	77 87	-109 85	1 4029	0 7050	di-	98-9 <sup>14</sup>	38-9				
71	3-Methyl-1,3-pentadiene	78 0 3		1 4494	0 7499							
72	trans-1,3,5-Hexatriene	78 5, 77 8 5		1 4884 <sup>13 5</sup>	0 74229 <sup>15</sup>	hexa-		78				
73	cis-1,3,5-Hexatriene	78 5		1 4577	0 7179							
74	3-Methyl-1,2-pentadiene	79 70		1 425	0 715							
75	2,4-Hexadiene	79 4 81 6 <sup>765</sup>	-79	1 4493	0 7152	2,5-di- tetra-	85 <sup>11</sup>	182	1 534 <sup>10</sup>	1 622 <sup>10</sup>		Maleic anhyd adduct, 95 6, Igr, SO <sub>2</sub> adduct, 43-3 5
76	3-Methyl-1,5-hexadiene	80-1		1 4116	0 7103							
77	4,4-Dimethyl-1,2-pentadiene (tert-Butylallene)	80-3			0 7184							
78	1,3-Cyclohexadiene	80 31 <sup>787</sup>	-104 8	1 4740	0 8413	di-  tetra- 2 forms		68, isomerizes → m 108 1, trans- 2, cis-3, trans-4, 92, 1, cis- 2, trans- 3, trans- 4, 156				Maleic anhyd adduct, 145-6, heptane, Benzoquinone adduct, 196 7, Igr
79	4,4-Dimethyl-cis-2-pentene	80 42	-135 46	1 4024	0 6996	di-	92 8 3 0 <sup>14</sup>		1 5080	1 5538		

\* Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous	
						x-Bromo-	B P °C	M P °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>		
80	3,4-Dimethyl-1-pentene	81		1.3995	0.701							
81	Cyclohexene	82.97	-103.51	1.44654	0.81096	di-	101.3 <sup>13</sup>		1.5445 <sup>19</sup>	1.7759 <sup>19</sup>		Mercaptosuccinic acid adduct, 150.5; 1.5, KMnO <sub>4</sub> oxid → adipic ac., 154, 2,4-Dinitrophenylsulfenyl chloride, 117.8; HBr → cyclohexyl bromide, b.p. 165
82	2,4-Dimethyl-2-pentene	83-4	-127.7	1.40165 <sup>22</sup>	0.6958 <sup>22</sup>	di-	88 <sup>17</sup>		1.50920 <sup>22, 5</sup>	1.5431 <sup>22, 5</sup>		
83	3-Methyl-1-hexene	84.0		1.397	0.695	di-	84.0-2 <sup>6</sup>		1.5028	1.5248		
84	2,3-Dimethyl-1-pentene	84.26	-134.8	1.4033	0.7051	di-	72.5-3.0 <sup>3</sup>		1.5028	1.5245		
85	3-Ethyl-1-pentene	85.13	-127.4	1.3980	0.6962	di-	93.5 <sup>15</sup>		1.5006	1.5251		
86	5-Methyl-1-hexene	85.31		1.3966	0.6920	di-	142.6-3.6 <sup>101</sup>		1.4970	1.5072		
87	5-Methyl-trans-2-hexene	86.0		1.400	0.700	di-	87.8 <sup>10</sup>		1.4960	1.5027		
88	2-Methyl-3-hexene	86.0		1.399	0.694	di-	96 <sup>19</sup>		1.5060	1.5310		
89	2,4-Dimethyl-2,3-pentadiene (Tetramethylallene)	86.5		1.40039	0.7006							
90	4-Methyl-1-hexene	86.73	-141.45	1.4000	0.6985	di-	94.7-5.7 <sup>11</sup>		1.4980	1.5027		
91	3,4-Dimethyl-2-pentene	87.0		1.407	0.713	di-	65.5-6.0		1.5104	1.5400		
92	4-Methyl-cis-2-hexene	87.37		1.4024	0.6996	di-	91.2 <sup>11</sup>		1.5045	1.5382		
93	4-Methyl-trans-2-hexene	87.6	-126.5	1.4023	0.6975	di-	91.2 <sup>11</sup>		1.5045	1.5382		
94	3,3-Dimethylcyclopentene	88		1.423	0.771							
95	2-Ethyl-3-methyl-1-butene	89		1.410	0.715	di-	72.5-3.5 <sup>4</sup>		1.5062	1.5261		
96	5-Methyl-cis-2-hexene	91		1.400	0.700	di-	89.90 <sup>11</sup>		1.4990	1.5152		
97	5-Methyl-1,4-hexadiene	91-2.5		1.4390	0.7258	1,2-di-	101.4 <sup>18</sup>		1.5233 <sup>16</sup>	1.566 <sup>16</sup>		
98	2-Methyl-1-hexene	92.0	-102.84	1.4034	0.7030	di-	100.5-1.5 <sup>23</sup>		1.5000	1.5066		
99	1,3-Dimethylcyclopentene	92		1.428	0.766							
100	2-Methyl-1,5-hexadiene	92.5 <sup>769</sup>		1.423/6 <sup>17, 3</sup>	0.7289 <sup>18, 5</sup>							Nitrosochloride, 75.6
101	2,4-Dimethyl-1,3-pentadiene	93	-114	1.4412	0.7368							
102	1,4-Dimethylcyclopentene	93.2		1.4283	0.779							
103	3-Methyl-trans-3-hexene	93.5		1.4107	0.7099							
104	1-Heptene	93.64	-119.03	1.39980	0.69698	di-	106.2 <sup>13</sup>		1.4990	1.5208		Mercaptosuccinic acid adduct 103.4-9

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous
						x Bromo	B P, °C	M P, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	
105	3-Methyl- <i>trans</i> -2-hexene	94 0		1 410	0 7120	<i>di</i> -	65 0 5 1 <sup>2</sup>		1 5040	1 5240	
106	2-Ethyl-1-pentene	94		1 405	0 708	<i>di</i> -	77 8 <sup>4</sup>		1 4990	1 4929	
107	3-Methyl- <i>cis</i> -3-hexene	95 35		1 4123	0 7132						
108	2-Methyl-2-hexene	95 41	-130 35	1 4106	0 7082	<i>di</i> -	73 0 1 <sup>8</sup>		1 4990	1 5116	
109	<i>trans</i> -3-Heptene	95 67	-136 63	1 4043	0 6981	<i>di</i> -	105 5 6 5 <sup>2,1</sup>		1 5010	1 5153	
110	<i>cis</i> -3-Heptene	95 75		1 4059	0 7030	<i>di</i> -	105 5- 6 5 <sup>2,3</sup>		1 5010	1 5153	
111	5-Methyl-1,2-hexadiene (Isobutylallene)	96		1 4282 <sup>19</sup>	0 7225 <sup>19</sup>						
112	3-Ethyl-2-pentene	96 01		1 4148	0 7204	<i>di</i> -	76 0- 4 <sup>3</sup>		1 5090	1 5426	
113	2,3-Dimethyl-2-pentene	97 5	-118 3	1 4208	0 7277	<i>di</i> -	97 9 <sup>15</sup>		1 517 <sup>22</sup>	1 547 <sup>22</sup>	
114	<i>trans</i> -2-Heptene	97 95	-109 48	1 4045	0 7012	<i>di</i> -	96 2 <sup>1,2</sup>		1 5000	1 5129	
115	3-Ethylcyclopentene	98 1		1 4319	0 7830						
116	<i>cis</i> -2-Heptene	98 5		1 406	0 708	<i>di</i> -	96 2 <sup>1,2</sup>		1 5000	1 5129	
117	5-Methyl-1,3-cyclohexadiene	100 5 1 5 <sup>7,6,2</sup>		1 4662 <sup>22,5</sup>	0 8252						
118	2,2-Dimethyl- <i>trans</i> -3-hexene	100 9		1 4063	0 7039	<i>di</i> -	96 5- 7 0 <sup>8</sup>		1 5032	1 4856	
119	1,4-Heptadiene	101		1 4202	0 7106	<i>di</i> -			1 5734	2 091	
120	2,4,4-Trimethyl-1-pentene	101 44	-93 48	1 4086	0 7150						
121	3,3-Dimethyl-1,5-hexadiene	101 6		1 4160	0 7249						
122	3,4-Dimethyl-1,5-hexadiene	101 8		1 4211	0 7304						
123	2,5-Dimethyl-3-hexene	102		1 406	0 710	<i>di</i> -	109 <sup>19</sup>		1 5058	1 5034	
124	5,5-Dimethyl-1-hexene	102 5		1 4049	0 709						
125	4-Methylcyclohexene	102 74	-115 5	1 4414	0 7947	<i>di</i> -	130 <sup>40</sup>			1 650 <sup>13</sup>	
126	3-Methylcyclohexene	104 0		1 4444	0 8010						
127	2-Isopropyl-3-methyl-1-butene	104		1 4085	0 722						
128	3,4,4-Trimethyl-1-pentene	104		1 412	0 719						
129	3,5-Dimethyl-1-hexene	104		1 404	0 708						
130	3,3-Dimethyl-1-hexene	104		1 4070	0 7140						
31	5,5-Dimethyl- <i>trans</i> -2-hexene	104 1		1 4055	0 7066						
32	2,4,4-Trimethyl-2-pentene	104 91	-106 33	1 4160	0 7218						
33	3,3,4-Trimethyl-1-pentene	105		1 4144	0 729						
34	2,2-Dimethyl- <i>cis</i> -3-hexene	105 4	-137 4	1 4099	0 7128						
35	1,2-Heptadiene ( <i>n</i> -Butylallene)	105 5 6 0		1 432 <sup>18</sup>	0 7306 <sup>18</sup>	2,3- <i>di</i> - <i>tetra</i> -	108- 10 <sup>12</sup> , 140 <sup>9</sup>		1 5200 <sup>18</sup>	1 5595 <sup>18</sup>	
36	1,2-Dimethylcyclopentene	105 8	-90 4	1 4448	0 7976				1 5718	2 0675	
37	4-Ethylcyclopentene	106		1 440	0 798						
38	4,4-Dimethyl-2-hexene	106		1 413	0 722	<i>di</i> -	92 3 <sup>4</sup>		1 5113	1 5148	
39	1-Ethylcyclopentene	106 3	-118 4	1 4410	0 7982						
40	5,5-Dimethyl- <i>cis</i> -2-hexene	106 9		1 4113	0 7169						

\*Derivative data given in order m p, crystal color, solvent from which crystallized



TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous
						x-Bromo-	B P °C	M P °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	
141	2-Methyl-2,4-hexadiene	107		1.4266 <sup>24</sup>	0.7439						
142	2-Methyl-1,3-cyclohexadiene	107.8		1.4662 <sup>18</sup>	0.8272 <sup>18</sup>						
143	3-Methyl-2,4-hexadiene	107.8		1.46146 <sup>15</sup>	0.7625 <sup>15</sup>						
144	4,4-Dimethyl-1-hexene	107.2		1.4102	0.7198	di-	224.5		1.5003	1.4689	
145	3-Ethyl-4-methyl-1-pentene	107.5		1.4097	0.7200						
146	2,4-Heptadiene	107.5-8.0		1.4578	0.7384						
147	2,4-Dimethyl-trans-3-hexene	107.6		1.4126	0.7145						
148	Quadricyclene (Quadricyclo [2,2,1,0 <sup>2,6</sup> ,0 <sup>3,5</sup> ] heptane)	108 <sup>740</sup> sl d		1.4804							
149	2,3,4-Trimethyl-1-pentene	108		1.415	0.729						
150	4-Methyl-1,3-hexadiene	108.10		1.4523	0.7558						
151	2,3,3-Trimethyl-1-pentene	108.3	-69	1.4174	0.7352						
152	4,5-Dimethyl-1-hexene	109		1.414	0.728						
153	1,5,5-Trimethylcyclopentene (Isolaurolene)	109 <sup>754</sup>		1.4324	0.7824						Reduces Tollen's reagent on warming
154	2,4-Dimethyl-cis-3-hexene	109		1.4140	0.7178						
155	3,3-Dimethyl-2-ethyl-1-butene	110		1.4159	0.728						
156	3-Ethyl-2-methyl-1-pentene	110		1.415	0.730						
157	4,5-Dimethyl-2-hexene	110		1.413	0.725						
158	1-Methylcyclohexene	110.0	-121	1.4503	0.8102	di-	100.2 <sup>12</sup>				2,4-Dinitrophenylsulfenyl chloride, 139.40
159	2-Ethyl-4-methyl-1-pentene	110.3		1.4105	0.7195						
160	3-Ethyl-1-hexene	110.3		1.407	0.715						
161	2,3-Dimethyl-1-hexene	110.5		1.4113	0.7214						
162	2,4-Dimethyl-2-hexene	110.6		1.4118	0.7213						
163	3-Methyl-1-heptene	111		1.406	0.711						
164	2,4-Dimethyl-1-hexene	111.2		1.4110	0.720						
165	2,5-Dimethyl-1-hexene	111.6		1.4105	0.7172						
166	3-Ethyl-3-methyl-1-pentene	112		1.418	0.7305						
167	3,4-Dimethyl-1-hexene	112		1.413	0.724						
168	3,4,4-Trimethyl-2-pentene	112		1.4232	0.7395						
169	3,5-Dimethyl-2-hexene	112		1.416	0.725						
170	2-Methyl-3-heptene	112		1.402	0.706						
171	5-Methyl-3-heptene	112		1.410	0.713						
172	2,5-Dimethyl-2-hexene	112.2		1.4140	0.720	di-	88 <sup>13</sup>		1.4740	1.3980	
173	3-Methyl-1,5-heptadiene	112.5		1.4230 <sup>22,5</sup>							
174	2-Ethyl-3-methyl-1-pentene	112.5		1.4142	0.729						

\* Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous
						α-Bromo-	B P, °C	M P °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	
175	4-Methyl-1-heptene	112.8		1.410	0.717						
176	6-Methyl-3-heptene	113 <sup>7,34</sup>		1.4114	0.7256	di-		97			
177	4-Ethyl-1-hexene	113		1.412	0.726						
178	4-Ethyl-2-hexene	113		1.412	0.725						
179	2-Isopropyl-1-pentene	113		1.414	0.725						
180	5-Methyl-1-heptene	113.3		1.4094	0.7164						
181	4-Methyl-2-heptene	113.5-4.1		1.4096	0.7154						
182	2,3-Dimethyl-3-hexene	114		1.416	0.728						
183	4-Methyl-2-octene	114		1.4100 <sup>25</sup>	0.7188 <sup>25</sup>						
184	2,4-Dimethyl-2,4-hexadiene	114-5		1.4545 <sup>716 5</sup>	0.7635 <sup>16 5</sup>						
185	6-Methyl-2,4-heptadiene	114.6		1.4397 <sup>25</sup>	0.7041 <sup>25</sup>						
186	3-Ethyl-4-methyl-trans-2-pentene	114.3		1.4210	0.7350						
187	Cycloheptene (Suberene)	114.38	-56	1.4580	0.8254	di-	unstable				Nitroschloride, 118 Oxid → pimelic ac., 105
188	1-Methyl-1,4-cyclohexadiene	114.5-4.8	< -70	1.4703	0.848	tetra-		171			
189	3-Ethyl-4-methyl-cis-2-pentene	115		1.424	0.739						
191	1,3,5-Cycloheptatriene (Tropilidene)	115.5	-79.49	1.5243							Maleic anhyd adduct, 104.2-5.0, CCl <sub>4</sub>
192	3,4-Dimethyl-2-hexene	116		1.418	0.737						
193	3-Ethyl-3-hexene	116		1.418	0.729						
194	6-Methyl-1,3-heptadiene	116.8			0.741 <sup>22</sup>						
195	2,5-Dimethyl-1,3-hexadiene	116.8	> -80	1.45024	0.7412						
196	2,3,4-Trimethyl-2-pentene	116.3	-113.3	1.4275	0.7434						
197	4,4-Dimethylcyclohexene	116.98	-80.5	1.4420	0.7996						
198	6-Methyl-2-heptene	117		1.412	0.718						
199	2-n-Propyl-1-pentene	117.7		1.4136	0.7240						
200	5-Methyl-2-heptene	118		1.414	0.723						
201	3,3-Dimethylcyclohexene	119		1.445	0.804						
202	2-Methyl-1-heptene	119.22	-87.38	1.41195	0.72025						
203	2,5-Dimethyl-1,5-hexadiene	119.23	solid at -80, liq at -23	1.45054	0.7637						
204	2-Ethyl-1-hexene	120		1.4157	0.7270						Mercaptosuccinic acid adduct, 101.9-2.7
205	d,l-1,2,3-Trimethylcyclopentene (Laurolene)	120.1 <sup>752</sup>		1.4421	0.7950						
206	4-Methyl-3-heptene	120.4		1.41712 <sup>25</sup>	0.7411 <sup>25</sup>						
207	3-Ethyl-2-hexene	121		1.424	0.737						
208	3-Methyl-3-heptene	121		1.418	0.728						
209	1-Octene	121.28	-101.76	1.40870	0.71492	di-	240.2, 118.5 <sup>15</sup>		1.4970	1.4580	Mercaptosuccinic acid adduct, 96.1-6

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous
						x Bromo	B P C	M P C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	
210	<i>trans</i> -4-Octene	121 4 <sup>79</sup>	f p -94	1 41157	0 71467	<i>di</i> ( <i>meso</i> )	103 <sup>8</sup>		1 4967 <sup>24</sup>	1 4525	
211	1,3-Cycloheptadiene (Hydrotropilidene)	121 52	-110 42		0 8929 <sup>8</sup>						H <sub>2</sub> → Cycloheptane b p 118 20
212	3-Methyl-2-heptene	121 6		1 4183	0 7296						
213	<i>cis</i> -4-Octene	121 7 <sup>79</sup>	f p -118	1 41361	0 72048	<i>di</i> ( <i>d l</i> )	84 0 8 4 <sup>4 3</sup>		1 4981	1 4569	
214	2,3-Dimethyl-2-hexene	121 8	-115 1	1 4268	0 7408						
215	3,4-Dimethyl- <i>trans</i> -3-hexene	122		1 430	0 747	<i>di</i>	85 7 <sup>5</sup>		1 5060	1 387	
216	6-Methyl-1-heptene	122 4 113 5		1 4070	0 7125						
217	<i>cis</i> -3-Octene	122 3 <sup>741</sup>	f p -126	1 41246	0 71888						
218	<i>trans</i> -3-Octene	122 4 <sup>741</sup>	f p -110 4	1 41241	0 71630						
219	2-Methyl-2-heptene	123 5		1 4138	0 7241						
220	<i>trans</i> -2-Octene	125 0	-87 7	1 4132	0 7199						Mercaptosuccinic acid adduct 142 9 3 5
221	<i>cis</i> -2-Octene	125 64	-100 2	1 4150	0 7243						
222	2-Methyl-1,3-heptadiene	127 8 4		1 4432	0 7432						
223	1,4-Dimethylcyclohexene	128		1 446	0 802						Nitrosochloride 83 4
224	1,5-Dimethylcyclohexene	128		1 448	0 8051						Nitrosochloride 118 9
225	2,6-Dimethyl 2-heptene	128 9		1 412	0 722						
226	4-Vinylcyclohexene	129 5 30 5 36 <sup>24</sup>		1 4623	0 8320	$\alpha \beta$ <i>di</i>		69 5 70 eth			
227	4-Methyl-2,4-heptadiene	131 2		1 4621	0 7551						
228	3,4-Dimethyl-2,4-hexadiene	132 4 71 3		1 4410	0 7832						
229	3-Methyl-2,4-heptadiene	132 5		1 4649	0 7667						HBr → Dihydrobromide b p 109 11 6
230	Bicyclo[4,2,0]oct-7-ene	132 5		1 4761		<i>di</i>	74 <sup>6</sup>				
231	4-Ethylcyclohexene	133		1 449	0 810						
232	1,6-Dimethylcyclohexene	133		1 454	0 815						
233	3,5-Dimethyl-2,4-heptadiene	133 44 4		1 4487	0 7728						
234	2,4-Octadiene	133 5 4 0		1 4542 <sup>2</sup>	0 7427 <sup>2</sup>						
235	2,5-Dimethyl-2,4-hexadiene	133 6 28 <sup>1</sup>	14 6 8	1 4796 <sup>1,2</sup>	0 7646 <sup>2</sup>	<i>tetra</i>		101			Oxid in air → polymeric peroxide 59
236	3-Ethylcyclohexene	134		1 451	0 814						
237	1,2,3,3-Tetramethylcyclopentene (Campholene)	134 5		1 44406	0 8035						
238	1-Ethylcyclohexene	136		1 4575	0 823						
239	1,2-Dimethylcyclohexene	137		1 4588	0 8250	<i>di</i>		142 3 acet			Nitrosochloride 58 60
240	1,3-Dimethylcyclohexene	137		1 445	0 802						
241	Bicyclo[4,2,0]oct-2-ene	137 9		1 4810 <sup>50</sup>	0 8948						

\*Derivative data given in order m p crystal color solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous
						x Bromo	B P °C	M P °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	
243	1-Methylcycloheptene	137.5-8.5		1.4581	0.8243 <sup>22</sup>						Nitroschloride, 106, Nitrosate, 97.8
244	2-Methyl-4-octene	138 <sup>713</sup>		1.4181	0.7392						Nitroschloride, 131
245	δ-Fenchene (1,5,5-Trimethylbicyclo[2,2,1]hept-2-ene)	139-40		1.44862	0.8433						
246	1,5,5-Trimethylcyclohexene (α-Cyclogeraniolene)	139-41 <sup>711</sup>		1.44612 <sup>41</sup>	0.7981 <sup>41</sup>						Nitroschloride, 100.20, aq me., al Nitrosate, 102.4
247	2,6-Dimethyl-2,4-heptadiene	139-43 <sup>712</sup>		1.4587 <sup>44</sup>	0.74820						
248	1,4,4-Trimethylcyclohexene (Pulenene)	139.5-40.5		1.444 <sup>25,2</sup>	0.8032 <sup>18,8</sup>	di-	120.05 <sup>10</sup>		1.5247 <sup>11</sup>	1.5324 <sup>11</sup>	Nitroschloride, 118.22, et ac
249	1,5,6-Trimethylcyclohexene	140		1.4572	0.831 <sup>5</sup>						
250	2,3-Dimethyl-2-norbornene (Santene 2,3-Dimethylbicyclo[2,2,1]-hept-2-ene)	140-1, 35 <sup>1</sup>		1.46699	0.8640						Dichloride 88.9, Nitrosate, 216d, Nitroschloride, 109.10 Nitrosite, 3 forms a) 122.4, b) 127-8, grn., c) 104, col
251	2,6-Dimethyl-1,3-heptadiene (Isogeraniolene)	140-2, 31		1.4606 <sup>22</sup>	0.7923 <sup>22</sup>						
252	Cyclooctatetraene	140.56, 142.3, 42.25 <sup>1</sup>	-4.68, -7	1.5290	0.9206						Maleic anhyd adduct, 167.8 Benzquinone adduct, 141, al Acrylic acid adduct 112.3, lgr AgNO <sub>3</sub> adduct, 173.4
253	7-Methyl-3-octene	141 <sup>716</sup>		1.4168	0.7278						
254	2,6-Dimethyl-1,5-heptadiene (Geraniolene)	141-2, 165.70	-70	1.44361 <sup>22</sup>	0.7626 <sup>22</sup>						
255	1,8-Nonadiene *	141-4		1.4302	0.7511						
256	1,3,5-Trimethylcyclohexene (Tetrahydro-mesitylene)	142.5-3.5		1.449 <sup>13,5</sup>	0.8025 <sup>14,5</sup>						Nitroschloride, 134
257	3-Methyl-2-octene	143-5 <sup>734</sup>		1.4247	0.7409 <sup>25</sup>						
258	Cyclooctene	143.8-4.5 <sup>723</sup>		1.4693							Br <sub>2</sub> → Bromocyclooctene, b p 7-8 <sup>23</sup> , n <sub>D</sub> <sup>20</sup> 1.5182, Dichloride, b p 130.4-0.6 <sup>23</sup> , m p -5, n <sub>D</sub> <sup>20</sup> 1.5061, D <sub>4</sub> <sup>20</sup> 1.1620
259	3,6-Dimethyl-2,4-heptadiene	144-6		1.46335 <sup>14</sup>	0.7853 <sup>9</sup>						
260	4-Nonene	144-6, 44.6 <sup>12</sup>		1.4212 <sup>18</sup>	0.732 <sup>18</sup>	di-	119.20 <sup>12</sup>		1.4988 <sup>17</sup>	1.410 <sup>17</sup>	
261	1,4,5-Trimethylcyclohexene	144-6		1.4482	0.805						

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous
						x-Bromo-	B P, °C	M P, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	
262	1-Vinylcyclohexene	145, 63 5 <sup>33</sup>		1 4950 <sup>19</sup>							50% H <sub>2</sub> SO <sub>4</sub> → dimer, b p 118-9 <sup>5</sup>
263	cis-1,4-Cyclooctadiene	145 1 <sup>758</sup>	-53		0 8754	tetra-		139			
264	1,3,5-Cyclooctatriene	145 6, 76 <sup>90</sup>		1 5035 <sup>25</sup>	0 8971 <sup>25</sup>						Maleic anhyd. adduct, 144-5, AgNO <sub>3</sub> adduct, 125-6, al
265	4,4-Dimethyl-1,7-octadiene	145 8		1 4330	0 7647						
266	ξ-Fenchene (2,7,7-Trimethylbicyclo[2,2,1]hept-2-ene)	146 2 6 8 <sup>752</sup>		1 4865	0 8626						[α] <sub>D</sub> <sup>20</sup> -24 1
267	1,6,6-Trimethylcyclohexene	146 2-7 2 <sup>767</sup> , 144 6		1 456 <sup>20 4</sup>	0 8217 <sup>20 3</sup>						Nitrosochloride, 133 4, et ac
268	1-Nonene	146 87	-81 37	1 41572		di-	141 5 <sup>20</sup>		1 4942	1 3980	
269	3-Nonene	147 4 <sup>750</sup>		1 4173	0 7294						
270	1,5-Cyclooctadiene	148 9		1 4905	0 8818 <sup>24</sup>						N-Bromosuccinimide → bromocyclooctadiene, b p 64 <sup>1 9</sup> , n <sub>D</sub> <sup>25</sup> 1 5410, D <sub>4</sub> <sup>25</sup> 1 3420
271	4-Methyl-3,5-octadiene	148 51		1 46285 <sup>25</sup>	0 7640 <sup>25</sup>						
272	7-Methyl-2,4-octadiene	149		1 4543 <sup>18</sup>	0 7521 <sup>18</sup>	tetra-	184 <sup>18</sup>				
273	1-Ethyl-4-methylcyclohexene	149, 153 4		1 453 <sup>16</sup>	0 8169 <sup>16</sup>						Nitrosochloride, 2 forms a) 103-4, pr, eth, b) 98 9, cr, eth
274	1-Ethyl-3-methylcyclohexene	149 51		1 454	0 8296						
275	2-Nonene	149 4 9 9		1 420 <sup>21</sup>	0 738 <sup>21</sup>						
276	1,2,3-Trimethylcyclohexene	149 6 150 <sup>749</sup>		1 463 <sup>12</sup>	0 8347 <sup>12</sup>						
277	1-Ethyl-5-methylcyclohexene	150		1 4527 <sup>25</sup>	0 812 <sup>25</sup>						
278	β-Fenchene (2,2-Dimethyl-5-methylenebicyclo[2,2,1]heptane)	150 5 3 5		1 46511	0 8599	di-		81-2			[α] <sub>D</sub> <sup>25</sup> +62 5, Nitrosochloride, 120
279	2,6-Dimethyl-2,5-heptadiene	150 6 1 0		1 4490							
280	2,7-Nonadiene	150 6	-72 5	1 4358	0 7499						
281	Allylcyclohexane (3-Cyclohexylpropene)	151		1 4536 <sup>13</sup>	0 8196 <sup>13</sup>	di-	143 4 <sup>16</sup>			1 537 <sup>0</sup>	
282	1-Ethylidene-4-methylcyclohexane	152-3		1 4571 <sup>21</sup>	0 81 <sup>21</sup>						Nitrosochloride, 2 forms a) 117-8, least soluble, b) 113-4, more soluble
283	4,5-Dimethyl-2,6-octadiene	152 9-3 8		1 4375 <sup>25</sup>	0 7611 <sup>25</sup>						
284	1-Ethylidene-3-methylcyclohexane	153		1 458 <sup>4</sup>	0 8135 <sup>19</sup>						Nitrosochloride, 114, acet
285	3,6-Dimethyl-2,6-octadiene	153-5		1 44453	0 7767						
286	2,6-Dimethyl-2,7-octadiene	155 6 <sup>720</sup>		1 4385 <sup>18</sup>	0 7605 <sup>18</sup>						

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous
						x Bromo	B P, °C	M P, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	
287	$\alpha$ -Pinene	156 0-6 3	-50	1 4560	0 8600	di-		169 70, al			Nitrosochloride, 109, Hydrobromide, 89, Nitrosobromide, 91 2d, Acid KMnO <sub>4</sub> → pinonic ac, 103-5
288	1-Ethylidene-2-methylcyclohexane	158		1 47	0 823 <sup>9</sup>						
289	2,4-Dimethyl-2,4-octadiene	161 3 <sup>716</sup>		1 4558 <sup>9 8</sup>	0 7802 <sup>9 8</sup>						
290	1,4,4-Trimethylcycloheptene (Eucarvene)	161-5 <sup>720</sup>		1 4561	0 8185						
291	$\beta$ -Pinene (Nopinene, Pseudopinene)	163-4		1 4782	0 8694						[ $\alpha$ ] <sub>D</sub> -22
292	2,7-Dimethyl-2,6-octadiene	163 5 4 5		1 44814	0 7849	tetra-		124-7			
293	3,7-Dimethyl-2,4-octadiene	164-7, 58 <sup>12</sup>		1 456	0 7933						
294	1-4-Carene (3,7,7-Trimethylbicyclo[2,2,1]hept-2-ene)	165 5 7 0 <sup>707</sup>		1 474 <sup>30</sup>	0 8552 <sup>30</sup>						[ $\alpha$ ] <sub>D</sub> <sup>20</sup> +62 2
295	Myrcene (2-Methyl-6-methylene-2,7-octadiene)	166		1 4722	0 7982						Maleic anh adduct, 33-4, 1,4-Naphthoquinone adduct, 81 Methodide, 130d
296	2,6-Dimethyl-2,6-octadiene	168, 56 <sup>14</sup>		1 45245 <sup>15</sup>	0 775 <sup>21</sup>						
297	1-3-Carene (3,7,7-Trimethylbicyclo[2,2,1]hept-3-ene)	168 9 <sup>705</sup> , 123 4 <sup>200</sup>		1 469 <sup>30</sup>	0 8586 <sup>30</sup>						[ $\alpha$ ] <sub>D</sub> <sup>20</sup> +7 69, Nitrosochloride, 100-1
298	3,8-o-Menthadiene (cis-3-Isopropenyl-4-methylcyclohexene)	169-70		1 4749	0 8507						
299	5-Decene	170 <sup>750</sup>	-112 to -111	1 4260	0 7474	di-	119 <sup>9</sup>		1 4912	1 3484	
300	p-8-Menthene (1-Isopropenyl-4-methylcyclohexane)	170		1 4523	0 8142						
301	d-m-8-Menthene (1-Isopropenyl-3-methylcyclohexane)	170		1 4546	0 8179						[ $\alpha$ ] <sub>D</sub> +9 73
302	l-m-8-Menthene (1-Isopropenyl-3-methylcyclohexane)	170-1		1 4574	0 8189						[ $\alpha$ ] <sub>D</sub> -8 06
303	6,8-o-Menthadiene (3-Isopropenyl-2-methylcyclohexene)	170 1		1 4758	0 8481						
304	5,8-o-Menthadiene (4-Isopropenyl-3-methylcyclohexene)	170-1		1 4778	0 8490 <sup>17</sup>						
305	1-Decene	170 57	-66 31	1 42146	0 74081	di-	145 160 <sup>18</sup>		1 4891 <sup>24</sup>	1 324 <sup>28</sup>	Mercaptosuccinic acid adduct, 93 5- 8
306	4-Decene	170 6		1 4243	0 7404						

\* Derivative data given in order m p, crystal color, solvent from which crystallized



TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous
						α-Bromo-	B.P., °C	M.P., °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	
307	<i>p</i> -Menthene (1-Isopropylidene-4-methylcyclohexane)	172-4		1.4568	0.819 <sup>21</sup>						Nitroschloride, 101-3
308	1-Isopropenyl-1,4-cyclohexadiene	172-6		1.5216	0.9068	tetra-		113			
309	<i>o</i> -Menthene (1-Isopropylidene-2-methylcyclohexane)	173, 160-2		1.467	0.8345						
310	<i>m</i> -Menthene (1-Isopropylidene-3-methylcyclohexane)	173-5		1.4670	0.8214						
311	α-Terpinene (1-Isopropyl-4-methyl-1,3-cyclohexadiene)	173.5 4.8 <sup>755</sup>		1.477	0.8375						Dihydrochloride, 53-4, me al, Dihydrobromide, 58.9, me al, Dihydroiodide, 76, me al, Nitrosite, 155, Maleic anhydride, 62, 66-7
312	2,4- <i>p</i> -Menthadiene (2-Isopropyl-5-methyl-1,3-cyclohexadiene)	174.6		1.4845 <sup>27</sup>	0.8441 <sup>22</sup>						
313	1-5-Isopropyl-2-methyl-1,3-cyclohexadiene	174-7		1.4732	0.8425						[α] <sub>D</sub> <sup>20</sup> -112.76, Nitrosite, α 120-1, β 105.6
314	1,5- <i>p</i> -Menthadiene (5-Isopropyl-2-methyl-1,3-cyclohexadiene)	175.6		1.4777	0.8463 <sup>25</sup>						[α] <sub>D</sub> +49.1, Nitrosite, α 113-4, β 105. Maleic anhydride, 126-7, pet eth
315	<i>d</i> -Silvestrene	175.8		1.4760	0.8479	tetra-		135			Dihydrochloride, 72, Nitroschloride, 106-7
316	<i>d</i> -Limonene	176.6-4		1.4743	0.8411	tetra-		104			Nitroschloride, 100-4, 2,4-Dinitrophenylsulfenyl chloride, 195-6
317	Isocarvestrene (5-Isopropenyl-1-methylcyclohexene)	176.7 <sup>65</sup>		1.4804	0.8496	tetra-		137-8, me al -chl			Dihydrochloride, 71.5, me al
318	1-3-Isopropenyl-1-methylcyclohexene	176-8	.....	1.4761 <sup>18</sup>	0.848 <sup>19</sup>						[α] <sub>D</sub> <sup>20</sup> -68.2, Dihydrochloride, 72
319	Dipentene ( <i>d,l</i> -Limonene)	177.6-8.0		1.4727 <sup>20</sup>	0.8402 <sup>20</sup>	tetra-		125, eth			Dihydrochloride, 50-1, al
320	3,8- <i>m</i> -Menthadiene (1-Isopropenyl-5-methylcyclohexene)	179 <sup>70</sup>		1.4972							[α] <sub>D</sub> +17.5
321	Menogerene (5-Isopropylidene-2-methyl-1,3-cyclohexadiene)	180.1 <sup>70</sup>		1.5005	0.8672	di-		115			
322	γ-Terpinene (1-Isopropyl-4-methyl-1,4-cyclohexadiene)	183		1.4765 <sup>14.5</sup>	0.849	tetra-		129-30, pet eth			[α] <sub>D</sub> <sup>20</sup> +36, Nitroschloride, 111, Nitrosate, 116d, ac a-me al
323	<i>d,l</i> -2,8- <i>m</i> -Menthadiene (1-Isopropenyl-3-methylcyclohexene)	184.7		1.503	0.864 <sup>20</sup>						

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES,  
DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous	
						<i>α</i> -Bromo	B P °C	M P °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>		
324	Menogene (3-Iso-propylidene-6-methylcyclohexene)	184 6 <sup>764.5</sup>		1 5026	0 8624							Nitrosite, 155, me al or chl, Maleic anh adduct, 205 8 Maleic anh adduct, 182
325	Terpinolene (4-Iso-propylidene-1-methylcyclohexene)	186		1 4883	0 8633 <sup>1/3</sup>	<i>di</i> -tetra-2 forms		69 70 a) 119, ac a, b) 122				
326	2-Undecene (2-Hendecene)	192 3, 78 5 <sup>14</sup>		1 43325	0 7735 <sup>1/3</sup>	<i>di</i> -	145 6 <sup>9</sup>					
327	5-Undecene (5-Hendecene)	192 2		1 4289	0 7511							
328	1-Undecene (1-Undecene)	192 67	-49 19	1 42609	0 75032	<i>di</i> -	186 <sup>13</sup>		1 4916	1 3122		
329	<i>cis</i> -Cyclododecene	194 5 <sup>740</sup>		1 4854	0 8770	<i>di</i> -		121				O <sub>3</sub> → Sebacic acid, 134 5
330	1-Dodecene	213 36 88 7 <sup>10</sup>	-35 23	1 43002	0 75836	<i>di</i> -		-15				
331	1-Tridecene	232 78 104 5 <sup>10</sup>	-23 07	1 4336	0 7653							
332	1-Tetradecene	251 1, 119 0 <sup>10</sup>	-12 85	1 43631	0 7713	<i>di</i> -		0				Mercaptosuccinic acid adduct, 104 0 8
333	Cedrene	262-3, 124 6 <sup>12</sup>		1 5001 <sup>19</sup>	0 9359 <sup>1/3</sup>							
334	1-Pentadecene	268 17, 133 7 <sup>10</sup>	-3 73	1 4389	0 77641	<i>di</i> -	204-5 <sup>17</sup>		1 4897	1 2235		
335	1-Hexadecene	284 4 103 9 <sup>1</sup>	4 12	1 44120	0 78112	<i>di</i> -	225 7 <sup>15</sup>	13 5, al				1% Hot KMnO <sub>4</sub> → <i>n</i> pentadecylic ac, 52 3, Mercaptosuccinic acid adduct, 105 0 8
336	1-Heptadecene	299 7, 116 <sup>1</sup>	11 2	1 4432	0 7852							
337	2-Methyl-2-heptadecene	314, 277 <sup>100</sup>	-2 5		0 7953	<i>di</i> -	267-8 <sup>28</sup>					
338	1-Octadecene	314 2, 128 <sup>1</sup>	17 6	1 4449	0 7888	<i>di</i> -		24, al				

\* Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 2) (B.p. at reduced pressure only. Listed alphabetically)

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Miscellaneous
1	Bicyclo[12,2,2]octadeca-14,16,18-triene	163 5 4 5 <sup>5</sup>		1 5204 <sup>25</sup>		Maleic anh adduct, 143 4
2	Bicyclo[4,2,0]oct-3-ene	81 <sup>140</sup>		1 4832		
3	Butylcyclooctatetraene	98 <sup>20</sup>		1 5083 <sup>25</sup>	0 8876 <sup>25</sup>	
4	<i>trans</i> -Cyclodecene	68-70 <sup>10</sup>		1 4822	0 8672	O <sub>3</sub> → Sebacic acid, 134 5
5	1,5,9,13-Cyclohexadecatetraene	93 8 <sup>0</sup> *		1 5472		
6	<i>trans</i> -Cyclononene	73 4 <sup>30</sup>		1 4799	0 8615	Phenylazide adduct, 97 8 8 2
7	1,3-Cyclooctadecadiene	115 <sup>3</sup>		1 4899	0 8814	
8	1,3-Cyclooctadiene	48 <sup>25</sup>	-57 to -55	1 4940 <sup>25</sup>	0 8699 <sup>25</sup>	
9	1,3,6-Cyclooctatriene	68 <sup>60</sup>	-62 to -56		0 8940 <sup>25</sup>	
10	1,3-Cyclotetradecadiene	106-8 <sup>3</sup>		1 4982	0 8723 <sup>25</sup>	Nitroschloride, 109-10, Nitrosate, 210d
11	1,2-Dimethylcyclooctatetraene	107 <sup>96</sup>		1 5219 <sup>25</sup>	0 8950 <sup>25</sup>	Maleic anh adduct, 184 5-5 5, bz -lgr, AgNO <sub>3</sub> adduct, 142 5 4 5, al
12	2,6-Dimethyl-2,5-octadiene	59 0- 5 <sup>12</sup>		1 4500	0 733	
13	Ethylcyclooctatetraene	81 <sup>37</sup>		1 5187 <sup>25</sup>	0 8996 <sup>25</sup>	Maleic anh adduct, 97 8 5, bz -cyclohexane, AgNO <sub>3</sub> adduct, 124-5 5, al
14	5-Methylcycloheptene	69 70 <sup>38</sup>		1 42016 <sup>31</sup>	0 76061 <sup>31</sup>	
15	Methylcyclooctatetraene	84 5 <sup>67</sup>		1 5249 <sup>25</sup>	0 8978 <sup>25</sup>	
16	7-Pentadecene	114 <sup>3 2</sup>		1 4420	0 7765	
17	Propylcyclooctatetraene	73 <sup>9</sup>		1 5131 <sup>25</sup>	0 8870 <sup>25</sup>	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

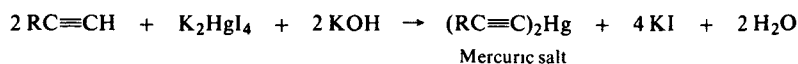
TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES,  
DIENES AND POLYENES

b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point, °C	Boiling point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous
						x Bromo	B p, °C	M p °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	
1	1-Nonadecene	23.4	328.0, 138.8 <sup>1</sup>	1.4445	0.7886						
2	Eicosene	28.6	341.2	1.4439 <sup>30</sup>	0.7882 <sup>30</sup>						
3	Bicyclo[4,7]pentadiene ( <i>endo</i> -4,7-Methylene-4,7,8,9-tetrahydroindene)	32	170	1.5070 <sup>25</sup>	0.9766 <sup>33</sup>						Phenylazide adduct, 128
4	1-Heneicosene	33.3	355	1.4494 <sup>S</sup>	0.7977 <sup>S</sup>						
5	1-Docosene	37.8		1.4505 <sup>S</sup>	0.8002 <sup>S</sup>						
6	1-Tricosene	41.6	379	1.4516 <sup>S</sup>	0.8023 <sup>S</sup>						
7	1-Tetracosene	45.3	390	1.4527 <sup>S</sup>	0.8045 <sup>S</sup>						
8	1-Pentacosene	48.7	401	1.4536 <sup>S</sup>	0.8063 <sup>S</sup>						
9	<i>cis cis cis</i> 1,4,7-Cyclononatriene	49.5-50									AgNO <sub>3</sub> adduct, 243d
10	<i>d,l</i> -Camphene (2,2-Dimethyl-3-methylenebicyclo[2,2,1]heptene)	50	159-60			<i>di</i> -	91-2	153.5 <sup>15</sup>			
11	<i>l</i> -Camphene	51.3	159-60								2,4-Dinitrophenyl-sulfonyl chloride, 121.2, Hydrochloride, 125-7
12	1-Heptacosene	54.7	421	1.4552 <sup>S</sup>	0.8097 <sup>S</sup>						
13	1-Triacontene	62.4	448	1.4573 <sup>S</sup>	0.8141 <sup>S</sup>						
14	1-Hentriacontene	64.6	457	1.4580 <sup>S</sup>	0.8153 <sup>S</sup>						
15	1-Dotriacontene	66.7	465	1.4585 <sup>S</sup>	0.8165 <sup>S</sup>						
16	1-Tritriacontene	68.7	473	1.4591 <sup>S</sup>	0.8176 <sup>S</sup>						
17	1-Tetatriacontene	70.5	481	1.4596 <sup>S</sup>	0.8186 <sup>S</sup>						
18	1-Pentatriacontene	72.3	489	1.4601 <sup>S</sup>	0.8196 <sup>S</sup>						
19	1-Hexatriacontene	73.9	496	1.4605 <sup>S</sup>	0.8205 <sup>S</sup>						
20	1-Heptatriacontene	75.5	503	1.4610 <sup>S</sup>	0.8214 <sup>S</sup>						
21	1-Octatriacontene	77	510	1.4614 <sup>S</sup>	0.8223 <sup>S</sup>						
22	1-Nonatriacontene	78.4	517	1.4618 <sup>S</sup>	0.8231 <sup>S</sup>						
23	1-Tetracontene	79.8	523	1.4622 <sup>S</sup>	0.8238 <sup>S</sup>						
24	Bicyclo(2,2,2)-oct-2-ene	111.2	128.34			2,3- <i>trans</i> - <i>di</i> -		55.0-5.5			

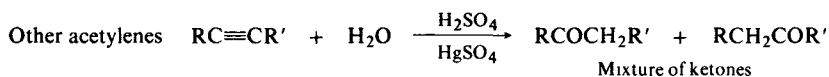
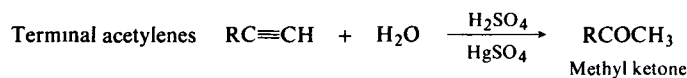
\*Derivative data given in order m p, crystal color, solvent from which crystallized  
S = Supercooled liquid at 20°

## EXPLANATIONS AND REFERENCES TO TABLE III

*Hg salt (Mercuric acetylide) \**

From the terminal alkyne and  $\text{K}_2\text{HgI}_4$  (prepared from mercuric chloride, potassium iodide and potassium hydroxide)

For directions and examples see Linstead, p 52, J R Johnson and W L McEwen, *J Amer Chem Soc*, **48**, 469 (1926)

*Hydration to form carbonyl compound*

From the alkyne in methanol and a catalyst composed of boron trifluoride etherate, red mercuric oxide and trichloroacetic acid

For directions and examples see J G Sharefkin and E M Boghosian, *Anal Chem*, **33**, 640 (1961)

From the alkyne, mercuric sulfate and sulfuric acid in 70% methanol, in 70% acetone or in 60% acetic acid

See Cheronis, p 576, H Erdmann and F Kother, *Z Anorg Chem*, **18**, 48 (1898), R J Thomas, K N Campbell and G F Hennion, *J Amer Chem Soc*, **60**, 718 (1938)

From the alkyne, mercuric oxide and sulfuric acid in alcohol

See J R Johnson, A M Schwartz and T L Jacobs, *J Amer Chem Soc*, **60**, 1882 (1938)

**NOTE** For directions and examples for the preparation of the semicarbazones and the 2,4-dinitrophenylhydrazones of the formed carbonyl compounds see explanations and references to Table IX and X, p 141, 142, 143

\*Derivatives recommended for first trial

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives

TABLE III. ORGANIC DERIVATIVES OF ALKYNES (ACETYLENES)

a) Liquids (Listed in order of increasing b.p.)\*

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Hydration product (RC≡CR' → RCOCH <sub>2</sub> R) and its derivatives				Hg salt	Miscellaneous
						Ketone	B p., °C	2,4-Dinitrophenylhydrazone of ketone	Semicarbazone of ketone		
1	Ethyne (Acetylene)	-84.0 (sat press)	-80.8, subl		0.6179 <sup>24</sup>	(Acetaldehyde)	(20.2)	(168)	(162-3)		
2	Propyne (Methyl acetylene)	-23.22	-102.7		0.6174 <sup>23</sup>	Acetone	56	128	190	204	
3	1-Butyne (Ethyl acetylene)	8.09, 8.3	-125.72	1.3962	0.6682 <sup>24</sup>	2-Butanone	82	116-7	135.6	162.3, al	
4	1,3-Butadiyne (Diacyetylene)	10.3	-35 to -36	1.4120	0.7249					161.5, 2.0	KOBr → 1,4-Dibromo deriv., 49.50, bz
5	3-Methyl-1-butyne (Isopropyl acetylene)	26.35, 28	-89.7	1.3723	0.666						Tetrabromo deriv., b p 275
6	2-Butyne (Dimethyl acetylene)	27.2, 6	-32.26	1.3921	0.6901	2-Butanone	82	116.7	135.6		Tetrabromo deriv., 243, eth., 2,4-Dinitrophenylsulfenyl chloride, 65.6
7	3-Methyl-3-buten-1-yne (Isopropenyl acetylene)	33		1.4158	0.6801 <sup>11</sup>						3,4-Dibromo deriv., b p 50.0-1.5 <sup>10</sup>
8	3,3-Dimethyl-1-butyne (tert-Butyl acetylene)	38.9	-81.20	1.37725 <sup>15</sup>	0.6737 <sup>15</sup>					92.5-3.0	Cu salt, 140, red
9	1-Pentyne (Propyl acetylene)	40.18	-105.7	1.3852	0.6901	2-Pentanone	102.3	145	112, 106	118.4	Tetrabromo deriv., b p 275
10	1-Penten-4-yne (Allyl acetylene)	42-3		1.4125 <sup>16</sup>	0.738 <sup>16</sup>	Allyl methyl ketone	111.2	160			1,2-Dibromo deriv., b p 79.5, 80.5 <sup>10</sup> , 4,4,5,5-Tetrabromo deriv., b p 132.6 <sup>10</sup>
11	cis-3-Penten-1-yne (cis-Propenyl acetylene)	44.6		1.4330						48	
12	trans-3-penten-1-yne (trans Propenyl acetylene)	52.2		1.4377	0.7270					155-7	1,2-Dibromo deriv., b p, 60-2 <sup>10</sup> , 3,4-Dibromo deriv., 66-76 <sup>10</sup>
13	2-Pentyne (Ethyl methyl acetylene)	56.07	-109.3	1.4039	0.7107	2-Pentanone + 3-Pentanone	102.3, 102	145, 156	112, 106, 138-9		KMnO <sub>4</sub> → formic ac + propionic ac
14	1-Penten-3-yne (Methyl vinyl acetylene)	59.2, 60.1		1.4496	0.7401						
15	4-Methyl-1-pentyne (Isobutyl acetylene)	61.1, 2, 99	-105.1	1.3936 <sup>15a</sup>	0.7092 <sup>15</sup>					100.0-5	
16	3-Methyl-1-pentyne (sec-Butyl acetylene)	65.70 <sup>70</sup> , 57.7		1.3916	0.7037					74-5	
17	1-Hexyne (Butyl acetylene)	71.33	-131.9	1.3989	0.7155	2-Hexanone	128	106.7	125	96.2, 4	
18	4-Methyl-2-pentyne (Isopropyl methyl acetylene)	72.0, 5	-110.37	1.4078 <sup>19</sup>	0.716 <sup>19</sup>						
19	4,4-Dimethyl-1-pentyne	73.5		1.4028	0.7154					125.6, 5	
20	1,3-Pentadiyne	75.0-5, 55-6	-45 to -35	1.4431 <sup>21</sup>	0.7375 <sup>21</sup>						
21	1,4-Hexadiyne	78-83			0.825 <sup>9</sup>						
22	3-Hexyne (Diethyl acetylene)	81.57 <sup>44</sup>	-51	1.4112 <sup>25</sup>	0.7263 <sup>25</sup>	3-Hexanone	125	130	112		2,4-Dinitrophenylsulfenyl chloride, 65.6

\*Derivative data given in order m p., crystal color, solvent from which crystallized

TABLE III. ORGANIC DERIVATIVES OF ALKYNES (ACETYLENES)

a) Liquids (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Hydration product (RC≡CR → RCOCH <sub>2</sub> R) and its derivatives				Hg salt	Miscellaneous
						Ketone	B p °C	2,4-Di-nitro-phenyl-hydrazone of ketone	Semicarbazone of ketone		
23	4,4-Dimethyl-2-pentyne ( <i>tert</i> Butyl methyl acetylene)	82.9-3.0		1.4071	0.7176						
24	2-Hexyne (Methyl propyl acetylene)	83.7-4.0	-92	1.4135	0.7317	2-Hexanone + 3-Hexanone	128 125	106.7 130	125 112		
25	1-Hexen-3-yne (Ethyl vinyl acetylene)	85 <sup>75k</sup>		1.4522	0.7492						1,2-Dibromo deriv b.p. 87.0-5 <sup>11</sup> 3,3,4,4-Tetra- bromo deriv b.p. 140-50 <sup>10</sup>
26	1,5-Hexadien-3-yne (Divinyl acetylene)	85.0	-87.83	1.5045	0.7857						
27	1-Hexen-4-yne	87 <sup>53</sup>		1.446 <sup>14</sup>	0.767 <sup>14</sup>						1,2-Dibromo deriv b.p. 93.0-5 <sup>1</sup> 1,2,4,5-Tetra- bromo deriv b.p. 154.5-50 <sup>10</sup>
28	3-Ethyl-1-pentyne	87.0-8.5		1.4102	0.7246						
29	1,5-Hexadiyne (Dipropargyl)	87.5 85 <sup>5k</sup> 20 <sup>46</sup>	-4.266	1.4381 <sup>23</sup>	0.79943						
30	2-Hexen-4-yne	88.9		1.4918	0.7710	Allyl ethyl ketone	74.5 6.5 <sup>90</sup>	95-106			
31	2-Methyl-3-hexyne	95.2	-116.7	1.4114	0.7263						
32	4-Methyl-2-hexyne	95.94	f.p. -107.63	1.4170	0.73855						
33	3-Ethyl-3-penten-1-yne	96.5		1.4338 <sup>25</sup>	0.7886 <sup>25</sup>						
34	5-Methyl-3-heptyne	98-100 <sup>10</sup>		1.4102	0.7360						
35	1-Heptyne ( <i>n</i> -Pentyl acetylene)	99.74	-80.9	1.4087	0.7328	2-Heptanone	151.2	89	123-127	61 me al	
36	5-Methyl-2-hexyne	102.46	-92.91	1.41762	0.73776						
37	8-Methyl-4-nonyne	104.5		1.4311	0.7681						
38	3-Heptyne (Ethyl propyl acetylene)	105.6		1.415	0.7337	4-Heptanone	144	75	132		
39	2-Heptyne ( <i>n</i> -Butyl methyl acetylene)	111.5-2.5		1.4230	0.748	2-Heptanone + 3-Heptanone	151.2 148	89	123-127 101		
40	2,2,5,5-Tetramethyl-3-hexyne (Di- <i>tert</i> -butyl acetylene)	111.9 <sup>74b</sup>	19.4	1.4055	0.7120						
41	1,6-Heptadiyne	112.30 <sup>26</sup>	-85	1.451 <sup>1</sup>	0.8164 <sup>17</sup>						
42	1-Octyne ( <i>n</i> -Hexyl acetylene)	126.2	-79.3	1.4159	0.7461	2-Octanone	173	64.5-58	124.5	80.4-7 me al	
43	4-Octyne (Di-propyl acetylene)	130.4-6 <sup>755</sup>		1.4226	0.7484						
44	3-Octyne (Butyl ethyl acetylene)	131.0-5		1.4261	0.748						
45	2-Octyne (Hexyl methyl acetylene)	138.0-4		1.4285	0.761	2-Octanone + 3-Octanone	173 169 70 <sup>73k</sup>	64.5-58 64.5	124.5 117.0-5		
46	4-Nonyne ( <i>n</i> -Butyl propyl acetylene)	150.4 <sup>752</sup>		1.4296 <sup>25</sup>	0.757 <sup>25</sup>	4-Nonanone + 5-Nonanone	187.8 188.4	57.8	73.4 90		

\*Derivative data given in order m.p., crystal color solvent from which crystallized



**TABLE III. ORGANIC DERIVATIVES OF ALKYNES (ACETYLENES)**

**a) Liquids (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Hydration product (RC≡CR' → RCOCH <sub>2</sub> R') and its derivatives				Hg salt	Miscellaneous
						Ketone	B p, °C	2,4-Dinitrophenylhydrazone of ketone	Semicarbazone of ketone		
47	1-Nonyne (Heptyl acetylene)	150.8	-50	1.4217	0.7568	2-Nonanone	195.3	55-6	118.20	67.8-85.5, me al	
48	3-Nonyne (Methyl pentyl acetylene)	153.5 <sup>745</sup> , 92 <sup>97</sup>		1.4299	0.7616	3-Nonanone + 4-Nonanone	187 <sup>751</sup> , 187-8	55-6, 57-8	111-2, 73.4		
49	Cyclooctyne	157.5-8.0 <sup>740</sup>		1.4850	0.868						
50	2-Nonyne (Methyl hexyl acetylene)	161		1.4331	0.769	3-Nonanone + 2-Nonanone	187 <sup>751</sup> , 195.3	55-6, 55-6	111.2, 118.20		
51	1,8-Nonadiyne	162, 55.0-5 <sup>13</sup>	-27.28	1.4490	0.8158						
52	1-Decyne ( <i>n</i> -Octyl acetylene)	174.0	-44	1.4265	0.7655	2-Decanone	215.5	124	63, 81	80.0-7	
53	3-Decyne (Ethyl hexyl acetylene)	175-6		1.433 <sup>21</sup>	0.7765 <sup>21</sup>	3-Decanone + 4-Decanone	211, 206.7		100.1, 51.2		
54	5-Decyne (Dibutyl acetylene)	177, 100 <sup>80</sup>	-73	1.4332	0.7688	5-Decanone		60.15	57.5-8.0	NaNH <sub>2</sub> at 210° → 1-Decyne, b p 174	
55	Cyclononyne	177.8 <sup>740</sup>	-36.4	1.4890	0.8972	Cyclo-nonanone	m p 34	146	184.5		
56	2,7-Nonadiyne	180	4.30	1.4674	0.8332						
57	1-Undecyne (1-Hendecyne, Nonyl acetylene)	195, 96.4 <sup>330</sup>	-25	1.4306	0.7728	2-Undecanone	228	63	122.0-5	79	
58	Cyclododecane	203.4 <sup>740</sup> , 78.5 <sup>12</sup>		1.4950	0.8975	Cyclo-decanone	100.2 <sup>12</sup>		203-5		Ozonolysis → sebacic acid, 134.5 NaNH <sub>2</sub> → 1-Dodecane, b p 215
59	6-Dodecane (Dipentyl acetylene)	209 <sup>745</sup> , 90 <sup>8</sup>		1.4380 <sup>25</sup>	0.7816 <sup>25</sup>						
60	1-Dodecane (Decyl acetylene)	215, 89.09 <sup>10</sup>	19	1.4340	0.7788					84.2-8	
61	1-Tridecane ( <i>n</i> -Undecyl acetylene)	234, 102.95 <sup>10</sup>	-5	1.4371	0.7842						
62	1-Tetradecane (Dodecyl acetylene)	252, 118.31 <sup>10</sup>	0	1.4396	0.7888						
63	1-Pentadecane (Tridecyl acetylene)	268, 129.79 <sup>10</sup>	10	1.4419	0.7928						
64	1-Hexadecane (Tetradecyl acetylene)	284.103.3 <sup>1</sup>	15	1.4440	0.7965						

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE III. ORGANIC DERIVATIVES OF ALKYNES (ACETYLENES)

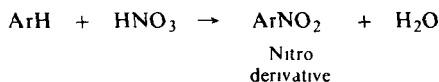
b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point °C	Boiling point °C	$n_D^{20}$	$D_4^{20}$	Miscellaneous
1	1-Heptadecyne	22	299	1.4437 <sup>25</sup>	0.7961 <sup>45</sup>	
2	2,6-Octadiyne	27	62 <sup>19</sup>	1.453 <sup>21</sup>	0.828 <sup>40</sup>	
3	1-Octadecyne	27	313	1.4474	0.8025	
4	2-Octadecyne	30	180		0.8016	
5	1-Nonadecyne	33	184 <sup>15</sup>	1.4488 <sup>S</sup>	0.8050 <sup>S</sup>	Hg salt, 96.7 n-BuOH
6	1-Eicosyne	35	327	1.444 <sup>1 S</sup>	0.8073 <sup>S</sup>	
7	2-Heneicosyne	35	340	1.4501 <sup>S</sup>		
8	1-Heneicosyne	35	153 <sup>1</sup>			
9	1-Docosyne	35	180 <sup>2</sup>	1.4499 <sup>40</sup>		
10	1-Tricosyne	41	180 <sup>2</sup>	1.4513 <sup>S</sup>	0.8094 <sup>S</sup>	
11	1-Tetracosyne	45	363	1.4524 <sup>S</sup>	0.8114 <sup>S</sup>	
12	1-Pentacosyne	49	374	1.4534 <sup>S</sup>	0.8131 <sup>S</sup>	
13	1-Hexacosyne	52	385	1.4544 <sup>S</sup>	0.8148 <sup>S</sup>	
14	1-Heptacosyne	55	395	1.4552 <sup>S</sup>	0.8163 <sup>S</sup>	
15	1-Octacosyne	57	405	1.456 <sup>S</sup>	0.8177 <sup>S</sup>	
16	1-Nonacosyne	60	415	1.4568 <sup>S</sup>	0.8190 <sup>S</sup>	
17	1-Triacontyne	62	426	1.4575 <sup>S</sup>	0.8202 <sup>S</sup>	
18	1-Hentriacontyne	65	432	1.4581 <sup>S</sup>	0.8213 <sup>S</sup>	
19	1-Dotriacontyne	67	441	1.4587 <sup>S</sup>	0.8224 <sup>S</sup>	
20	1-Tritriacontyne	69	449	1.4593 <sup>S</sup>	0.8234 <sup>S</sup>	
21	1-Tetracontyne	71	457	1.4598 <sup>S</sup>	0.8243 <sup>S</sup>	
22	1-Pentatriacontyne	73	464	1.4603 <sup>S</sup>	0.825 <sup>S</sup>	
23	1-Hexatriacontyne	74	472	1.4608 <sup>S</sup>	0.8260 <sup>S</sup>	
24	1-Heptatriacontyne	76	479	1.4612 <sup>S</sup>	0.8268 <sup>S</sup>	
25	1-Octatriacontyne	77	486	1.4617 <sup>S</sup>	0.8275 <sup>S</sup>	
26	1-Nonatriacontyne	79	493	1.4621 <sup>S</sup>	0.8282 <sup>S</sup>	
27	1-Tetracontyne	80	499	1.4625 <sup>S</sup>	0.8289 <sup>S</sup>	
		82	505	1.4628 <sup>S</sup>	0.8295 <sup>S</sup>	
		83	512	1.4632 <sup>S</sup>	0.8301 <sup>S</sup>	

Derivative data given in order m p crystal color solvent from which crystallized  
 S = supercooled liquid at 20°

## EXPLANATIONS AND REFERENCES TO TABLE IV

## Nitro derivative \*



From the aromatic hydrocarbon with concentrated nitric and sulfuric acids

For directions and examples see Cheronis, p 578 80, Linstead, p 48, 49, Shriner, p 249, Vogel, p 520, Wild, p 24

From the aromatic hydrocarbon with fuming and concentrated nitric acids

See Shriner, p 249, Wild, p 24

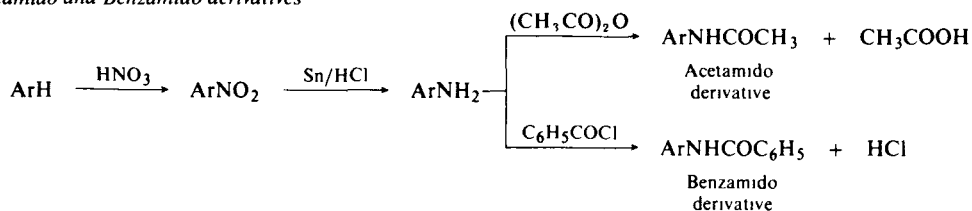
From the aromatic hydrocarbon with fuming nitric acid in acetic acid

See Vogel, p 520

From the aromatic hydrocarbon with nitric and sulfuric acids in chloroform

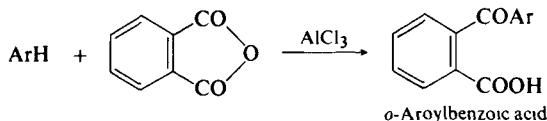
See Vogel, p 580

## Acetamido and Benzamido derivatives \*



Nitration of the aromatic hydrocarbon is followed by reduction with tin and hydrochloric acid. The resulting amine is acetylated with acetic anhydride or benzoylated with benzoyl chloride.

For directions and examples see Cheronis, p 581, V L Ipatieff and L A Schmerling, *J Amer Chem Soc*, **59**, 1056 (1937), **60**, 1476 (1938), **65**, 2470 (1943)

*o*-Aroylbenzoic acid (product with phthalic anhydride)

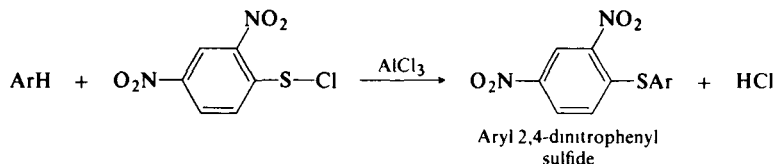
From the aromatic hydrocarbon, phthalic anhydride and aluminum chloride in carbon disulfide

For directions and examples see Cheronis, p 548, Shriner, p 250, Vogel, p 519, Wild, p 28, H W Underwood and W L Walsh, *J Amer Chem Soc*, **57**, 940 (1935)

From the aromatic hydrocarbon, phthalic anhydride and aluminum chloride without solvent

See G F Lewenz and K T Serijan, *J Amer Chem Soc*, **75**, 4087 (1953)

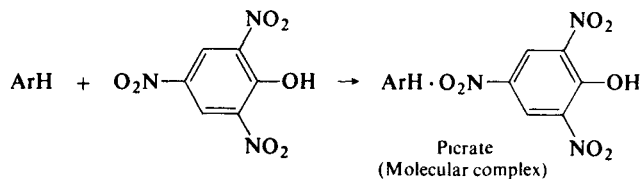
## 2,4-Dinitrobenzenesulfonyl chloride derivative (Aryl 2,4-dinitrophenyl sulfide)



From the aromatic hydrocarbon, 2,4-dinitrobenzenesulfonyl chloride and aluminum chloride in 1,2-dichloroethane

For directions and explanations see Cheronis, p 585, C M Buess and N Kharasch, *J Amer Chem Soc*, **72**, 3529 (1950)

## Picrate



\*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives.

## EXPLANATIONS AND REFERENCES TO TABLE IV (Continued)

From the aromatic hydrocarbon and picric acid in alcohol

For directions and examples see Linstead, p 50 Vogel, p 518, Wild, pp 29 30

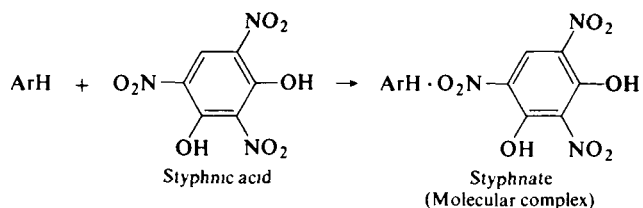
From excess of liquid aromatic hydrocarbon and picric acid without solvent

See Wild, pp 28 9 Baril and Hauber, *J Amer Chem Soc*, **53**, 1087 (1931)

From the aromatic hydrocarbon in methanol or in dry benzene

See Cheronis, pp 582 3

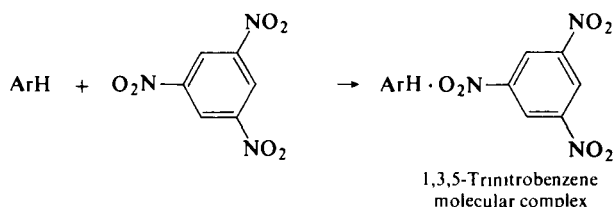
### Styphnate



From the aromatic hydrocarbon and styphnic acid (2,4,6-trinitroresorcinol) in acetic acid

For directions and examples see Vogel, p 519, W J Hickinbottom, *Reactions of Organic Compounds*, 2nd ed., Longmans, Green and Co., London, 1948, p 76

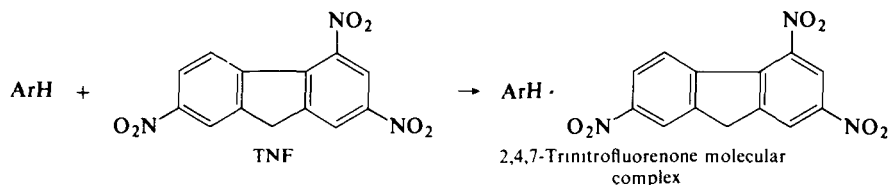
### 1,3,5-Trinitrobenzene derivative



From the aromatic hydrocarbon and 1,3,5-trinitrobenzene in alcohol, acetic acid, or benzene

For directions and examples see Vogel, p 519

### 2,4,7-Trinitrofluorenone (TNF) derivative \*



From the aromatic hydrocarbon and 2,4,7-trinitrofluorenone in methanol-benzene and ethanol-benzene mixtures

For directions and examples see Cheronis, pp 582 3, M Orchin, *J Amer Chem Soc*, **68**, 1727 (1946), M Orchin, L Reggel and E O Woolfolk, *J Amer Chem Soc*, **69**, 1225 (1947)

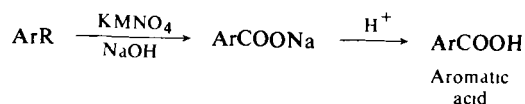
From the aromatic hydrocarbon and 2,4,7-trinitrofluorenone in glacial acetic acid

See M C Kloetzel and H E Mertel, *J Amer Chem Soc*, **72**, 4786 (1950), M D Soffer and R A Stewart, *J Amer Chem Soc*, **74**, 567 (1952)

From the aromatic hydrocarbon and 2,4,7-trinitrofluorenone without solvent

See D E Laskowski and W C McCrone, *Anal Chem*, **30**, 542 (1958)

### Acids from side-chain oxidation



\*Derivatives recommended for first trial

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLE IV (Continued)

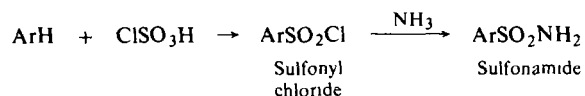
From the alkyl-substituted aromatic hydrocarbon with potassium permanganate in sodium hydroxide or sodium carbonate solution

*For directions and examples see* Cheronis, p 585, 627, Linstead, p 50, Shriner, p 250, Vogel, p 520, Wild, p 26

From the alkyl-substituted aromatic hydrocarbon with sodium bichromate and sulfuric acid

*See* Cheronis, p 627, Shriner, p 250, Wild, p 26

*Sulfonamide* \*



From the aromatic hydrocarbon and chlorosulfonic acid in chloroform, followed by aqueous ammonia

*For directions and examples see* Linstead, p 49, Wild, p 27, E H Huntress and F H Carten, *J Amer Chem Soc*, 62, 511 (1940), E H Huntress and J S Autenrieth, *J Amer Chem Soc*, 63, 3446 (1941)

From the aromatic hydrocarbon with chlorosulfonic acid without solvent, followed by ammonolysis with dry ammonium carbonate

*See* Wild, p 27

\*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

a) Liquids. (Listed in order of increasing b.p.)\*

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Picrate	1,3,5 Trinitro benzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4-Di-nitro-phenyl sulfonyl chloride derivative	Miscellaneous
1	Benzene	80.1	5.5	1.5011	0.87901	84		1,3-di 89, 1,3,5 tri 122		127	120	Sulfonamide, 156
2	Toluene	110.6	-95	1.49613	0.86694	88.2, pale yellow		2,4-di 70	2,4-di 221	137	102.3	Oxid → benzoic acid, 121, Sulfonamide, 137
3	Ethylbenzene	136.2	-93.9	1.49594	0.86690	96.6, pale yellow		2,4,6-tri 37	2,4-di 223	122, 128	97	Oxid → benzoic acid, 121, Sulfonamide, 109
4	1,4-Xylene	138.3	13.26	1.49581	0.86105	90		2,3,5-tri 139		132, 148	134-5	Oxid → terephthalic acid, >300, subl., Sulfonamide, 147
5	1,3-Xylene	139.1	-47.89	1.49722	0.86417	91		2,4,6-tri 183		126, 142		Oxid → isophthalic acid, 348, h.w., Sulfonamide, 137
6	1,2-Xylene	144.4	-25.18	1.50545	0.88020	88		4,5-di 118		178		Oxid → phthalic acid, 206.8, Sulfonamide, 144
7	Isopropylbenzene (Cumene)	152.4	-96.04	1.49146	0.86179			2,4,6-tri 109	4-mono 106, 2,4-di 216	133		Oxid → benzoic acid, 121 Sulfonamide, 106
8	n-Propylbenzene	159.2	-99.59	1.49202	0.86204	103		2,4-di b.p. 150 <sup>1</sup>	4-mono 96, 2,4-di 208	125		Oxid → benzoic
9	1-Ethyl-3-methylbenzene (m-Ethyltoluene)	161.3	-96.55	1.49661	0.86455							Oxid → isophthalic acid, 348, h.w.
10	1-Ethyl-4-methylbenzene (p-Ethyltoluene)	162.1	-62.35	1.49500	0.86118							Oxid → terephthalic acid, >300, subl.
11	1,3,5-Trimethylbenzene (Mesitylene)	164.7	-44.72	1.49937	0.86518	97		2,4-di 86, 2,4,6-tri 235		212		Oxid → trimelic acid, 380, Sulfonamide, 141
12	1-Ethyl-2-methylbenzene (o-Ethyltoluene)	165.2	-80.83	1.50456	0.88069							Oxid → phthalic acid, 206.8
13	tert-Butylbenzene	169.1	-58.34	1.49266	0.86650			2,4-di 62, 2,4,6-tri 124	4-mono 170, 2,4-di 210		130.1	Oxid → benzoic acid, 121
14	1,2,4-Trimethylbenzene (Pseudocumene)	169.4	-43.91	1.50484	0.87582	97		3,5,6-tri 185				Oxid → trimellitic acid, 225.35 d
15	Isobutylbenzene	172.8	-51.53	1.48646	0.85321				4-mono 127.075		99.100	Oxid → benzoic acid, 121
16	sec-Butylbenzene	173.3	-75.57	1.49020	0.86207			2,4-di b.p. 161.2 <sup>5</sup>	4-mono 126, 2,6-di 192		88-9	Oxid → benzoic
17	3-Isopropyl-1-methylbenzene (3-Isopropyltoluene, m-Cymene)	175.1	-63.75	1.4930	0.8610							

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

a) Liquids. (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Picrate	1,3,5-Trinitrobenzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4-Di-nitrophenyl sulfonyl chloride derivative	Miscellaneous
18	1,2,3-Trimethylbenzene (Hemimellitene)	176.08	-25.41	1.51393	0.89438	90.5						Oxid → hemimelitic acid, 190.7 d
19	trans-Propenylbenzene	176.575	-27.1 to -25.9	1.5463 <sup>25</sup>	0.902							
20	Indane	177	-51.4	1.5381	0.9645							
21	4-Isopropyl-1-methylbenzene (4-Isopropyltoluene, 4-Cymene)	177.1	-67.94	1.4909	0.8537			2,6-di-54, 2,3,6-tri 118		123.4		Sulfonamide, 115
22	2-Isopropyl-1-methylbenzene (2-Isopropyltoluene 2-Cymene)	178.35	-71.71	1.5006	0.8766							Br <sub>2</sub> → Tetrabromo, 59.5-60.5
23	1,3-Diethylbenzene	181.1		1.49552	0.86394			2,4,6-tri 62		114		
24	1-Methyl-3-propylbenzene (m-Propyltoluene)	181.8		1.4936	0.8610							
25	Indene	182.4	-2	1.5764	0.9915	98, yel						Acid → polymer
26	n-Butylbenzene	183.27	-88.15	1.48979	0.86013				4-mono 105, 2,4-di 214	97	72.3	
27	1-Methyl-4-propylbenzene (p-Propyltoluene)	183.3		1.4919	0.8584							
28	1,2-Diethylbenzene	183.4		1.50346	0.87996							
29	1,4-Diethylbenzene	183.8		1.49483	0.86196							
30	1,3-Dimethyl-5-ethylbenzene	183.8	-84.4	1.4981	0.8648			2,4,6-tri 117.0, 7.6				Br <sub>2</sub> → Tribromo, 89
31	1-Methyl-2-propylbenzene (o-Propyltoluene)	184.8	-60.2	1.4998	0.8744							
32	2,2-Dimethyl-1-phenylpropane (Neopentylbenzene)	186		1.4880	0.858							
33	1,4-Dimethyl-2-ethylbenzene	186.9		1.5043	0.8772			3,5,6-tri 127.8, al	4-mono 142, 2,4-di 181			Sulfonamide, 107-8
34	2-Methylindane	187.0		1.5070	0.9034							
35	3-Methyl-2-phenylbutane	188		1.486	0.8701				4-mono 147.8, 2,4-di 193			4-Benzamido deriv, 141.2
36	1-Methylindane	188.90		1.5274	0.939							Heat with Pt at 310-350 → Naphthalene, 80.3
37	1,3-Dimethyl-4-ethylbenzene	188.4	-63.0	1.5038	0.8763			2,5,6-tri 127.5, 9.0				Br <sub>2</sub> → 2,5,6-Tri-bromo, 94.5, 81.2
38	3-tert-Butyl-1-methylbenzene (3-tert-Butyltoluene)	189.3	-41.39	1.4944	0.8657							
39	1,2-Dimethyl-4-ethylbenzene	189.55	-67.1	1.5031	0.8745							Oxid → trimelitic acid, 225.35 d
40	1,3-Dimethyl-2-ethylbenzene	190		1.5107	0.8904							Oxid → hemimelitic acid, 190-7 d

\*Derivative data given in order: m.p., crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

a) Liquids. (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	Picrate	1,3,5-Trinitrobenzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4-Dinitrophenylsulfenyl chloride derivative	Miscellaneous
41	3-Phenylpentane	191		1.4877	0.8649				4-mono 145.6 2,4-di 199.200			4-Benzamido deriv., 154
42	1-Ethyl-3-isopropylbenzene	192		1.4955	0.859							
43	2-Methyl-2-phenylbutane	192.38		1.4934	0.8737				4-mono 142 2,4-di 181			4-Benzamido deriv. 112.3
44	4-tert-Butyl-1-methylbenzene (4-tert-Butyltoluene)	192.8	-52.49	1.4918	0.8612			2,6-di 96				
45	1-Ethyl-2-isopropylbenzene	193		1.5080	0.888							
46	2-Phenylpentane	193		1.4876	0.8576				4-mono 107 2,4-di 181.2			4-Benzamido 127.8
47	1,2-Dimethyl-3-ethylbenzene	193.9	-49.5	1.5117	0.8921							Oxid → hemmel- litic acid 190.7 d
48	3-sec-Butyl-1-methylbenzene (3-sec-Butyltoluene)	194		1.490	0.858							
49	3-Isobutyl-1-methylbenzene (3-Isobutyltoluene)	194		1.4888	0.8536							
50	d-2-Methyl-1-phenylbutane	194		1.4880	0.8617							
51	1,3-Dimethyl-5-isopropyl- benzene	194.5 191		1.4955	0.8591							Oxid → trimesic acid, 380
52	2-Phenyl-cis-2-butene	194.5		1.5402 <sup>25</sup>	0.9191 <sup>2</sup>						81.2	
53	4-Isobutyl-1-methylbenzene (p-Isobutyltoluene)	196		1.4874	0.8517							
54	2-sec-Butyl-1-methylbenzene (2-sec-Butyltoluene)	196		1.497	0.873							
55	2-Isobutyl-1-methylbenzene (o-Isobutyltoluene)	196		1.4935	0.8649							
56	1,4-Dimethyl-2-isopropyl- benzene	196.2		1.5010	0.8738							
57	1-Ethyl-4-isopropylbenzene	196.6		1.4923	0.8585							
58	d,l-2-Methyl-1-phenylbutane	197		1.486	0.859				4-mono 115.6 2,4-di 193.4			4-Benzamido 126
59	1,2,3,5-Tetramethylbenzene (Isodurene)	197.9		1.5125	0.8899			4,6-di 181.157		213		
60	3-Methyl-1-phenylbutane (Isopentylbenzene)	198.9 196		1.4847	0.8558				4-mono 114 2,4-di 215.6			
61	1,3-Dimethyl-2-isopropyl- benzene	199		1.509	0.890							
62	1,3-Dimethyl-4-isopropyl- benzene	199.1 195		1.5018	0.869							
63	3-Methylindene	199.2 200 198.5		1.55907 <sup>27</sup>	0.9640	76.8, or- yel, al						
64	4-sec-Butyl-1-methylbenzene (p-sec-Butyltoluene)	200		1.4932	0.8650							

\*Derivative data given in order m.p., crystal color, solvent from which crystallized



TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

a) Liquids. (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	Picrate	1,3,5-Trinitrobenzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4-Di-nitro-phenyl sulfenyl chloride derivative	Miscellaneous
65	2- <i>tert</i> -Butyl-1-methylbenzene (2- <i>tert</i> -Butyltoluene)	200.5		1.5076	0.8897							
66	3,5-Diethyl-1-methylbenzene (3,5-Diethyltoluene)	200.7	-74.12	1.4969	0.8630			2,4,6- <i>tri</i> 106.65				
67	2-Butyl-1-methylbenzene (2-Butyltoluene)	201.208		1.4958	0.8721							
68	1-Ethyl-3-propylbenzene	201		1.4930	0.8607							
69	1,2-Dimethyl-4-isopropylbenzene	201.8		1.4993	0.8699							
71	1,2-Dimethyl-3-isopropylbenzene	202.6		1.508	0.888							
72	1-Ethyl-2-propylbenzene	203		1.4992	0.8744							
73	1,3-Di-isopropylbenzene	203.2	-63.1	1.4883	0.85593			4,6- <i>di</i> 76.972, 2-ProH				
74	1,2-Diethyl-4-methylbenzene	203.6		1.5039	0.8762							
75	1,2-Di-isopropylbenzene	203.8		1.4960	0.8771							
76	1,4-Dimethyl-2-propylbenzene	204.3		1.4999	0.8717							
77	1,2,3,4-Tetramethylbenzene (Prehnitene)	205.0	-6.3	1.5201	0.9053	92-5		5,6- <i>di</i> 176				
78	1-Ethyl-4-propylbenzene	205		1.4921	0.8594							
79	3-Butyl-1-methylbenzene ( <i>m</i> -Butyltoluene)	205		1.491	0.859							
80	2,4-Diethyl-1-methylbenzene (2,4-Diethyltoluene)	205		1.5027	0.8748							
81	<i>n</i> -Pentylbenzene	205.4	-75	1.4878	0.8585				4- <i>mono</i> 101-2, 2,4- <i>di</i> 202			4-Benzamido, 128.9
82	3-Methyl-3-phenylpentane	206		1.4958	0.8755							
83	1,3-Dimethyl-5- <i>tert</i> -butylbenzene	206-6.5	-21.5	1.4958	0.8645			2,4,6- <i>tri</i> 107 (one form), 114 (another form)				
84	1,3-Dimethyl-4-propylbenzene	206.6		1.4998	0.8723							
85	1,2-Diethyl-3-methylbenzene	206.6		1.5105	0.8910							
86	4-Butyl-1-methylbenzene (4-Butyltoluene)	207		1.490	0.857							
87	2,5-Diethyl-1-methylbenzene (2,5-Diethyltoluene)	207.1		1.5034	0.8758							
88	1,2,3,4-Tetrahydronaphthalene (Tetralin)	207.6	-35.79	1.54135	0.9702			5,7- <i>di</i> 95		153.5		Cl <sub>2</sub> + 5,6,7,8-Tetrachloro, 172
89	1,3-Diethyl-2-propylbenzene	207.6		1.5063	0.8856							
90	2,6-Diethyl-1-methylbenzene (2,6-Diethyltoluene)	208.8		1.5106	0.8907							
91	1,2-Dimethyl-4-propylbenzene	208.9		1.5000	0.8715							
92	1,3-Dimethyl-5-propylbenzene	209		1.4933	0.8610							
93	2-Methyl-3-phenylpentane	209		1.4912	0.8678							
94	4- <i>tert</i> -Butyl-1,3-dimethylbenzene	210-4		1.5030 <sup>37</sup>	0.9372 <sup>30</sup>			2,5,6- <i>tri</i> 112, al				
95	1,4-Di-isopropylbenzene	210.4	-17.1	1.48983	0.85676							
96	1,2-Dimethyl-3-propylbenzene	210.7		1.5075	0.8864							

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS**
**a) Liquids. (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Picrate	1,3,5-Trinitrobenzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfonyl chloride derivative	Miscellaneous
97	1- <i>tert</i> -Butyl-4-ethylbenzene	211		1.4950	0.8635			2,6- <i>di</i> 94 5, al				
98	<i>d,l</i> -3-Phenylhexane	211 208.3		1.4867	0.8596				2,4- <i>di</i> 207.8			
99	2-Ethyl-1,3,5-trimethylbenzene	212.4	-12.2	1.5074	0.883			4,6- <i>di</i> 111, al				
100	3-Ethyl-4-isopropyl-1-methylbenzene	213		1.5006	0.8722							
101	5-Ethyl-1,2,4-trimethylbenzene	213	-13.5	1.5075	0.833			3,6- <i>di</i> 87.8, al				3,6-Dibromo, 60-1, acet
102	6-Ethyl-1,2,4-trimethylbenzene	213		1.5118	0.8897							
103	2-Phenylhexane	214		1.4882	0.8600				2,4- <i>di</i> 178			
104	2-Methyl-1-phenylpentane	215		1.4847	0.8624							
105	4-Isopropyl-1-propylbenzene	215		1.4972	0.8614							
106	1,3-Dipropylbenzene	215.8		1.5155 <sup>11</sup>	0.9137 <sup>1</sup>							
107	5-Ethyl-1,2,3-trimethylbenzene	215.8		1.5101	0.8863							
108	3-Ethyl-1,2,4-trimethylbenzene	216.6		1.5133	0.895			5,6- <i>di</i> 79.80, al				
109	1,2,4-Triethylbenzene	217.7		1.4982	0.8791							
110	1,3,5-Triethylbenzene	218 211.2		1.4965	0.8568 <sup>25</sup>			2,4,6- <i>tri</i> 112.4 2.6		129		2,4,6-Tribromo, 105
111	2-Methyl-1,2,3,4-tetrahydronaphthalene (2-Methyltetralin)	218		1.5311	0.952							
112	1-Methyl-1,2,3,4-tetrahydronaphthalene (1-Methyltetralin)	219		1.5357	0.9580							
113	4-Ethyl-1,2,3-trimethylbenzene	220.4		1.5180	0.9019							
114	1,4-Dipropylbenzene	221		1.4914	0.8564							
115	3-Methyl-1-phenylpentane	221		1.4876	0.8605							
116	2-Propyl-1,3,5-trimethylbenzene	221		1.5033	0.8782							
117	1,1-Dimethyl-1,2,3,4-tetrahydronaphthalene (1,1-Dimethyltetralin)	221		1.5292	0.950			<i>Ar-x, x-di</i> 64.5				
118	3- <i>tert</i> -Butyl-1-isopropylbenzene	222		1.4832	0.8512							
119	1-Methyl-3-pentylbenzene (3-Pentyltoluene)	223		1.4911	0.8593							
120	4- <i>tert</i> -Butyl-1-isopropylbenzene	224		1.4872	0.8665							
121	2-Methyl-2-phenylhexane	225		1.4943	0.8737							
122	2,4-Di-isopropyl-1-methylbenzene (2,4-Di-isopropyltoluene)	225		1.4990	0.8664							
123	3-Methyl-3-phenylhexane	226		1.4980	0.8776							
124	<i>n</i> -Hexylbenzene	226.1	-61.2	1.4864	0.8575				2,4- <i>di</i> 205.6			
125	3-Phenylheptane	227		1.4862	0.8607							
126	2,6-Di-isopropyl-1-methylbenzene (2,6-Di-isopropyltoluene)	228		1.5032	0.8768							

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

a) Liquids. (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	Picrate	1,3,5 Trinitro benzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4 Di nitro phenyl sulfonyl chloride derivative	Miscellaneous
127	5-Propyl-1,2,4-trimethylbenzene	228		1.5095	0.887							
128	6-Methyl-1,2,3,4-tetrahydronaphthalene (6-Methyltetralin)	229		1.5357	0.9537							
129	2,2-Dimethyl-1,2,3,4-tetrahydronaphthalene (2,2-Dimethyltetralin)	230		1.5200	0.935							
130	2-Phenylheptane	231		1.4863	0.8610							
131	5-Methyl-1,2,3,4-tetrahydronaphthalene (5-Methyltetralin)	234.4		1.54395	0.9720							
132	2-Ethyl-1,2,3,4-tetrahydronaphthalene (2-Ethyltetralin)	235		1.523	0.938							
133	Cyclohexylbenzene	235-6	7-8	1.5329	0.9502							
134	1-Ethyl-1,2,3,4-tetrahydronaphthalene (1-Ethyltetralin)	236		1.5321	0.9535							
135	2,5-Dimethyl-1,2,3,4-tetrahydronaphthalene (2,5-Dimethyltetralin)	236		1.526	0.946							
136	2,8-Dimethyl-1,2,3,4-tetrahydronaphthalene (2,8-Dimethyltetralin)	236		1.526	0.941							
137	2,7-Dimethyl-1,2,3,4-tetrahydronaphthalene (2,7-Dimethyltetralin)	237.8		1.526	0.941							
138	2,6-Dimethyl-1,2,3,4-tetrahydronaphthalene (2,6-Dimethyltetralin)	238		1.526	0.941							Oxid → trimellitic acid, 225-35 d
139	1,4-Di-sec-butylbenzene	239		1.4892	0.8590							
140	1,5-Dimethyl-1,2,3,4-tetrahydronaphthalene (1,5-Dimethyltetralin)	239		1.526	0.9410							
141	3-Ethyl-3-phenylhexane	239		1.4943	0.875							
142	6-Ethyl-1,2,3,4-tetrahydronaphthalene (6-Ethyltetralin)	241		1.5331	0.9568							
143	2-Methyl-1-phenyl-1-butene	241.2		1.528 <sup>18</sup>								Nitrosit, 129-30
144	5-Ethyl-1,2,3,4-tetrahydronaphthalene (5-Ethyltetralin)	242		1.540	0.973							
145	n-Heptylbenzene	244		1.4875	0.8595							
146	1-Methylnaphthalene	244.8	-30.57	1.6174	1.02025	142, or-red, al	153.5, 4.5, al	4-mono 71, 4,5-di 143		68		Styphnate, 135, al
147	5,6-Dimethyl-1,2,3,4-tetrahydronaphthalene (5,6-Dimethyltetralin)	252		1.552	0.975							Oxid → melo phanic acid, 238-42
148	6,7-Dimethyl-1,2,3,4-tetrahydronaphthalene (6,7-Dimethyltetralin)	252	10	1.5360	0.954			5,8 di 203				
149	5,7-Dimethyl-1,2,3,4-tetrahydronaphthalene (5,7-Dimethyltetralin)	253.1	-6	1.5405	0.9583							Heating with S at 320° → 1,3-Dimethylnaphthalene, b p 263

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS**

**a) Liquids. (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	Picrate	1,3,5-Trinitrobenzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
150	5,8-Dimethyl-1,2,3,4-tetrahydronaphthalene (5,8-Dimethyltetralin)	254		1.547	0.967							Heating with S at 230° → 1,4-Dimethylnaphthalene, b p 268
151	2-Ethynaphthalene	257.9	-7.5	1.59761	0.9922	77.0	88.9, 2-					Styphnate, 88.90
152	1-Ethynaphthalene	258.67	-13.88	1.6062	1.00816	75.0, al	PrOH					Styphnate 111.3, al
153	1,7-Dimethylnaphthalene	263	-13	1.60831	1.0115	121	137					Styphnate, 143
154	1,6-Dimethylnaphthalene	263	-14	1.6072	1.003	114.5	139					Styphnate, 122
155	1,3-Dimethylnaphthalene	263	-4.0	1.6078	1.0063	or, al	yel					Styphnate, 117.8, w-me al, 2,4,7-Trinitrofluorenone deriv, 142.5, or
156	n-Octylbenzene (1-Phenyl-octane)	264.5	-36	1.4845	0.8562			2,4-di 2				
157	1-Allylnaphthalene	265.7		1.6140	1.0228	69						
158	1-Isopropyl-naphthalene	267.9	-16	1.5950	0.99565	85.6						Dimer 198.5, 9.5
159	1,4-Dimethylnaphthalene	268, 262-4	7.66	1.6127	1.0166	144, or, me al	165.6					Tetrabromo, 141.2
160	1,1-Diphenylethane	268-70		1.5761	1.0033							Styphnate, 126-7 or me al
161	2-Isopropyl-naphthalene	a) 268.2		1.5772	0.9795	93.5, 91.3						Oxid → benzophenone, 49
162	2-Propyl-naphthalene	b) 262, 273.5, 277.9		1.5861, 1.5872	0.9770	93.4, or al	99					
163	1-Propyl-naphthalene	277, 272.5	-10	1.5952	0.9918	91.2	86.7, al					
164	1,3,7-Trimethylnaphthalene	280	13.5	1.5759	1.007	144, or, al						Styphnate 151.5 or me al
165	1-Isopropyl-7-methylnaphthalene (Apocadene)	282		1.5884	0.9833	102, or, al						Styphnate, 166 (163-4), yel, al
166	n-Nonylbenzene (1-Phenyl-nonane)	282	-24	1.4838	0.8558							4-Sulfonamide, 94.5-5.0
167	2-Butyl-naphthalene	283-5, 292	-8.1	1.57774	0.9673	71.3, or-yel, al						Maleic anhydride → 3-(4-Nonylbenzoyl) acrylic acid, 82.3
168	2-tert-Butyl-naphthalene	285-90	-4	1.5768	0.9687	102.3						
169	1-tert-Butyl-naphthalene	287.9		1.5726	0.9629	96, yel						
170	1-Butyl-naphthalene	289.34	-19.76	1.5819	0.97673	104.5, or-yel						

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

a) Liquids. (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Picrate	1,3,5-Trinitrobenzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfonyl chloride derivative	Miscellaneous
171	4,5-Benzindane (1,2-Cyclopentanonaphthalene)	294.5		1.6290	1.066	110	119.20					2,4,7-Trinitrofluorenone deriv., 133
172	<i>n</i> -Decylbenzene (1-Phenyldecane)	300	-14.38	1.48319	0.85553							
173	1-Pentyl-naphthalene	307	-22	1.5725	0.9656		75, yel					
174	2-Pentyl-naphthalene	310	-21	1.5694	0.9561		74, yel					
175	<i>n</i> -Undecylbenzene ( <i>n</i> -Hendecylbenzene, 1-Phenylundecane)	316	-5	1.4828	0.8553							4-Sulfonamide, 95.7.6.2
176	1-Hexyl-naphthalene	322	-17.7	1.5647	0.9566		69.74					
177	2-Hexyl-naphthalene	324	-5.6	1.620	0.9479		67-8, yel					
178	<i>n</i> -Dodecylbenzene (1-Phenyl-dodecane)	331	3	1.4824	0.8551							4-Sulfonamide, 97.5
179	1-Heptyl-naphthalene	340		1.5582	0.9491							
180	2-Heptyl-naphthalene	341	1	1.5556	0.9410							
181	Tridecylbenzene (1-Phenyl-tridecane)	346	10	1.4821	0.8550							
182	1-Octyl-naphthalene	356	-2.0	1.5532	0.9427							
183	2-Octyl-naphthalene	357	2 forms stable -0.5, meta-stable 13	1.5501	0.9356							
184	1-Nonyl-naphthalene	372		1.5477	0.9371							
185	2-Nonyl-naphthalene	372	12	1.5454	0.9298							
186	1-Decyl-naphthalene	387		1.5435	0.9322							

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

b) Solids. (Listed in order of increasing m.p.)\*

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	sym-Tri-nitro-benzene derivative	2,4,7-Tri-nitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Di-nitro phenyl sulfonyl chloride derivative	Miscellaneous
1	1,2,6-Trimethylnaphthalene	14	146 <sup>10</sup>	122-3, al	150-1, al						n <sub>D</sub> <sup>20</sup> 1 6010
2	Diphenylmethane	26 7	264 7, 261 2, 120 <sup>10</sup>					2,4,2',4'-tetra 172			n <sub>D</sub> <sup>20</sup> 1 5770, D <sub>25</sub> <sup>25</sup> 1 0056, CrO <sub>3</sub> → Benzophenone, 49 n <sub>D</sub> <sup>25</sup> 1 5725
3	1,2,3-Trimethylnaphthalene	27 8, al	125-30 <sup>12</sup>	143, or , al	143 5, yel	154 6, al					
4	1,6,7-Trimethylnaphthalene	28, me al	285, 138 <sup>12</sup>	125 6, or , me al	148-9, or , me al	142-3, yel , me al					
5	2-Isopropylazulene	31, bl - vlt				di 113 4					
6	1,4-Dimethyl-7-isopropyl-azulene (δ-Guaiazulene)	31 5, bl - vlt , al	167-8 <sup>12</sup>	122 2 5, bl , al	105-6, bl , me al	151-1 5					D <sub>19</sub> <sup>19</sup> 0 9728 (super- cooled) 2,4,6-Tri- nitrotoluene deriv , 89
7	2,6-Dimethylphenanthrene	33-4, me al		135 6, yel , al	148 50, yel , me al						
8	1,2,5-Trimethylnaphthalene	33 5, 31-2, al	147 8 <sup>11</sup>	138 40, al	131, al	159-60, al					n <sub>D</sub> <sup>20</sup> 1 6110, D <sub>20</sub> <sup>20</sup> 1 0103, 2,4,6-Tri- nitrotoluene deriv , 90 0 5
9	1-Propylphenanthrene	34 5, me al		100-1, yel , me al							
10	5-Isopropylazulene	34 5				134, 122 3					
11	2-Propylphenanthrene	35-6, al	170 <sup>0,2</sup>	91 2, al							
12	2-Methylnaphthalene	37-8, 34 4	240-2, 110-2 <sup>16</sup>	116, al		123, yel	125 6, al	1-mono 81			CrO <sub>3</sub> → β-Naphthoic acid, 182
13	1-Ethyl-5-methylnaphthalene	40, al	133 <sup>10</sup>	97, or , al							
14	9-Isopropylphenanthrene	41-2		109-10							
15	6-Isopropylazulene	43				124					
16	2-Ethyl-6-methylnaphthalene	44 5	145 50 <sup>11</sup>	109, or	119, yel	116-7, yel					2,4,6-Trinitrotoluene deriv , 62, yel
17	2-Isopropylphenanthrene	44-5, al		108, yel , me al							
18	6-Isopropyl-1-methyl-phenanthrene	45-6		143, or							
19	2-Ethylazulene	45 5, 44-5, bl		110 1		107					
20	2,5-Dimethylphenanthrene	46 7, al	204-5 <sup>15</sup>	127-9, yel , al	132-3, or , al						
21	1,3,5-Trimethylnaphthalene	47, me al	139 5 <sup>10</sup>	141-2, me al	138, yel						
22	3-Ethyl-6-methylphenanthrene	47-8		156-6 5, or							
23	2-Methylazulene	47-8		130-1, bl , al		140-1, dk red, al					
24	1,3,8-Trimethylnaphthalene	48, me al		127 5, or , al	140 5, al						
25	4-Methylphenanthrene	49 50, 95% al		140-1, al	135, or , al						

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

b) Solids. (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	Picrate	Styphnate	sym Tri-nitro-benzene derivative	2,4,7-Tri-nitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Di-nitro-phenyl sulfenyl chloride derivative	Miscellaneous
26	1,4-Dimethylphenanthrene	50 1 (cor), me al		143 5, or -yel	135 5 6 5, or						
27	Bibenzyl (1,2-Diphenylethane)	53	284			102		4,4-di-180, 2,2',4,4-tetra-169		132 3	D <sub>30</sub> <sup>m</sup> 0 9782, CrO <sub>3</sub> → Benzoic acid, 121
28	Methylenefluorene (Biphenylencethylene)	53		152 3							
29	3,5-Dimethylphenanthrene	53 4, me al		139, or , me al	124 5 or -yel						
30	1,3-Dimethylazulene	54		164 6		164 6, al					
31	7-Methyl-3,4-benzphenanthrene	54 0 4 5, al		134 0 4 5, red, al			178 5 8 8				
32	Pentamethylbenzene	54 3, 51	231 8	131		121		6-mono-154			
33	1,2,4-Trimethylnaphthalene	55-6 50, me al	146 <sup>12</sup>	148 8 5, or me al	123 5, yel , me al	165 6 5, me al					
34	3,3'-Dimethylstilbene (sym-Di-m-tolyethylene)	55 6		97							
35	1,4,5,7-Tetramethylnaphthalene	56	162 5 <sup>11</sup>	153			152 8 3 4				
36	1,2,4,8-Tetramethylnaphthalene	56 7	150 <sup>10</sup>	145 5		167, red, me al					2,4,6-Trinitrotoluene deriv , 88 yel
37	2,9-Dimethylphenanthrene	56 7, al		138, yel , al							
38	1,5-Dimethylphenanthrene	57 8, me al		134 5, or , me al							
39	2-Benzyl-naphthalene	58	350	93 4, yel , al			124 3 5 4				D <sup>m</sup> 1 176
40	1-Benzyl-naphthalene	58 9	350	103-4, yel							D <sup>1</sup> 1 166
41	1,2-Dimethylazulene	58 9, bl , al		129 30, blk , al		166 7 br -blk , al					
42	9-Propylphenanthrene	59	265 70 <sup>22</sup>	99, yel , al							
43	1,7-Dimethyl-4-isopropyl-naphthalene	60, al -w		92, or -red, al	120, yel						
44	3-Methylphenanthrene	62-3	140 50 <sup>8</sup>	137-8, yel , al							
45	3,4-Dimethylphenanthrene	62 3, me al		129-30, or -red, al	142 3, or -red, al						
46	1-Ethylphenanthrene	62 5, al		108-9, or , al	144, yel , al						
47	sym-Diphenylacetylene (Tolane)	62 5, al		111, yel		96, yel					
48	9-Ethylphenanthrene	62 5 3 0, 66, bz -pet eth	198 200	123-4, or -red, al							D <sub>30</sub> <sup>m</sup> 1 0603 n <sub>D</sub> <sup>20</sup> 1 6582

\* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

b) Solids. (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point, °C	Picrate	Styphnate	<i>sym</i> -Tri-nitro benzene derivative	2,4,7 Tri-nitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4 Di-nitro phenyl sulfonyl chloride derivative	Miscellaneous
49	1,4,5-Trimethylnaphthalene	63	145 <sup>12</sup>	144 5, red, al	129 30						In H <sub>2</sub> SO <sub>4</sub> sol → grn
50	4-Methylfluorene	63, al									
51	1,4,6,7-Tetramethylnaphthalene	63 4, al		148 9			172 4 3 4				
52	1,2,3-Trimethylphenanthrene	63 8 4 8		187 8, or		200 7 1 5, yel, bz -al					
53	1,8-Dimethylnaphthalene	65 63	140 <sup>18</sup>	156 148	160						
54	8-Methyl-3,4-benzphenanthrene	65 6, al		107 8, red, al							
55	2-Ethylphenanthrene	67 8, me al 64 5		95 5 6 0, yel, al, 92 3			180 7 0 9				
56	3,4-Benzphenanthrene	68, al		120 8-8 5, red, al			170 8 1 1				
57	1,3,7-Trimethylphenanthrene	68 9 me al		163 4 al	160 1						
58	4-Isopropyl-1-methylphenanthrene	68 8 5 me al		113 6 4 or, al							
59	4,8-Dimethylazulene	69 70, bl, al		157-8, blk al		179 80 red-br, al					
60	Biphenyl	69 2 71	254 5 145 <sup>22</sup>					4 4'-di 237 229, 2,2',4,4'-tetra 150	225	142 3	n <sub>D</sub> <sup>20</sup> 1 475 D <sub>4</sub> <sup>20</sup> 0 866
61	2-Methyl-3,4-benzphenanthrene	70 4-1 0 al		141 8 3 2, red, bz -al		145 bz pet eth	158 8 5, or red, aq al				Conc H <sub>2</sub> SO <sub>4</sub> sol → yel with grn fluorescence on heating → olive grn with vlt fluorescence
62	3-Methylpyrene	71 2, al		211-2, br -red, bz							
63	1,4,7-Trimethylphenanthrene	72 3		141 2, me al	129 30						
64	1,4-Dimethylantracene	74, al		140							
66	4,9-Dimethyl-1,2-benzanthracene	75 me al		116, br, me al		124-5, red, me al					Dibromide, 116 d
67	Benzfluorene (ω-Phenyl-dibenzfulvene)	76, al		115 6							
68	1,3-Dimethylphenanthrene	76 7, ac a		153 5, or, al	165 6						
69	1-Methyl-3,4-benzphenanthrene	77 8	210 <sup>9 4</sup>	112-3, red, al			171 8 2 2				
70	3-Isopropyl-1-methylphenanthrene	79	180 <sup>1 5</sup>	150	155						

\* Derivative data given in order m p, crystal color, solvent from which crystallized



TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

b) Solids. (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	sym Tri-nitrobenzene derivative	2,4,7-Tri-nitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Di-nitrophenyl sulfonyl chloride derivative	Miscellaneous
71	1,2'-Binaphthyl	79-80, 76		127-0-75 (cor), or			145-0-69				
72	2,3-Dimethylphenanthrene	79-80		146-7, or -red, al	147-8, or, al						
73	1,2,4,5-Tetramethylbenzene (Durene)	79-2, 80	196-8					3,6-di-205	263		
74	1-Ethyl-2-methylphenanthrene	80, me al		134-5, me al		152-5-30					
75	1,5-Dimethylnaphthalene	80-0-0-5, 85% al		140							
76	6-Methyl-3,4-benzphenanthrene	80-1, al	206-8 <sup>2</sup>	118-0-8-5, red, me al			144-2-4-5				
77	Naphthalene	80-3	218	149		153	153-4	1-mono-61, 57	172	173-4	
78	1,3,6,8-Tetramethylnaphthalene	81	115-6 <sup>2</sup>	151-2		175-6					
79	1-Ethyl-7-methylphenanthrene (Homopimanthrene)	81, al		115-6, yel, me al							Quinoxaline deriv, 154, ac a
80	9-Methylanthracene	81-5	196-7 <sup>12</sup>	137-d, red-br							D <sub>1</sub> <sup>99</sup> 1065, n <sub>D</sub> <sup>99</sup> 16959, Irradiation in acetone → dimer, 228-0-8-5 Photo-oxide, ca 80, exp
81	1-Isopropyl-7-methylphenanthrene	82-3	170 <sup>1</sup>	119-20, or	148-9, yel	163-4, yel					
82	6-Methylazulene	83, bl-vlt		137, 125		141					
83	1,3-Dimethylanthracene	83		136							bl fluorescence
84	2,2'-Dimethylstilbene (sym-Di-o-tolyethylene)	83	176-80 <sup>10</sup>	102							
85	1-Methylanthracene	85-6, me al	199-200	115-6-6-2, red, me al	176-4-7-0, red, me al		219-0-9-8, red, bz				D <sub>1</sub> <sup>99</sup> 10471, n <sub>D</sub> <sup>99</sup> 16802, Irradiation → dimer, 246
86	1,7-Dimethylphenanthrene	86		132, me al	159, me al						
87	1,6-Diphenylnaphthalene	86-7		106-8							
88	1,6-Dimethylphenanthrene	87-8, me al		134, yel, al							
89	1,9-Dimethylphenanthrene	88, al		163-5, or -yel, me al	181						
90	9-Methylphenanthrene	90-1, aq al		152-3, al							
91	1,2,10-Trimethylanthracene	90-6-1-4, yel		138-5-9-5, al		169-6-170-2, al					
92	7-Ethyl-1-methylphenanthrene	91-0-1-5, 84-5			141-2	135-6					
93	Triphenylmethane	92	358					4,4',4''-tri-206			Br <sub>2</sub> → bromo deriv, 152
95	5-Isopropyl-naphthanthracene	92, ac, a		157							

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

b) Solids. (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point °C	Picrate	Styphnate	sym Tri-nitro benzene derivative	2,4,7-Tri-nitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Di-nitro phenyl sulfonyl chloride derivative	Miscellaneous
96	3,9-Dimethyl-1,2-benzanthracene	93		137-8, red, al		145, red, bz-lgr					
97	5,6-Benzindane (2,3-Cyclopentenonaphthalene)	94		120-1							
98	12-Isopropyl-naphthanthracene	94.5, al		157.8							
99	Acenaphthene	96.2, yellow, al	278	162, orange-red, al		168, yellow, al	175.6	5-mono 101	198	187.9, d	$n_D^{20}$ 1.6066, $D_1^{20}$ 1.0242, 1,2-Di-bromide, 121.3
100	2,7-Dimethylnaphthalene	96.7, al	262	136.0-6.5, yellow, me al	158.0-9.5, yellow, me al						
101	7-Isopropyl-1-methylfluorene	96.5-7.0, al						di ca 245			
102	Azulene	98.5-99	270 d, 115, 35 <sup>10</sup>	120 d		167					Heat at 270° → Naphthalene, 80.3, 2,4,6-Trinitrotoluene deriv., 95.5-100
103	Retene (7-Isopropyl-1-methylphenanthrene)	100.5-101, al	390, 158.6, 5 <sup>9,2</sup>	124-5	141.2	139					D 1.035
104	Phenanthrene	101, al, 96.3	340, 332	144, 132.8		158, 145	197			250.1	$n_D$ 1.5973, D 1.182
105	2,7-Dimethylphenanthrene	101.2, me al		152.3, or, al							
106	2,3,6-Trimethylnaphthalene	102, 92.3	286, 146-8 <sup>14</sup>	130, yellow, me al	165, yellow, me al						
107	2-Phenylnaphthalene	102-3					169.5, 70.5, 182.4				
108	1,2,3,4-Tetrahydroanthracene	103-5									
109	2,3-Dimethylnaphthalene (Guarene)	104.0-4.5 (subl), al	265-6	123.4							$D_1^{20}$ 1.008
110	Ethylidene fluorene	104, al		155.6							Dibromide, 93.5
111	1,7-Dimethylfluorene (Gibberene)	107.0-7.5		85-6, orange-red		98, yellow, al					In H <sub>2</sub> SO <sub>4</sub> sol → bl
112	1,1'-Dinaphthylmethane	110, al	>360, 270 <sup>14</sup>	142		141.5	216				
113	Fluoranthrene	110		185.6			216				
114	2,6-Dimethylnaphthalene	111	261-2	143			156				
115	2,4-Dimethylphenanthrene	111, al		138-9, 142, me al							
116	Fluorene	113.5, 116-7	293-5	87, 77		105	179	2-mono 156, 2,7-di 199	228		CrO <sub>3</sub> → Fluorenone, 84
117	4,10-Dimethyl-1,2-benzanthracene	114, pale yellow, me al		162, blk							
118	4H-Cyclopenta(def)phenanthrene (Phenanthrindene)	116, al	353	166							Benzylidene deriv., 108
119	1,3,8-Trimethylphenanthrene	116		174-5		188	199				
120	11-Methylnaphthanthracene	117-8		159-60, dk red		170, or	238.2, 8.6				

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

b) Solids. (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	sym-Tri nitro-benzene derivative	2,4,7-Tri nitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Di-nitro-phenyl sulfenyl chloride derivative	Miscellaneous
121	5-Methylchrysene	117.2 7.8, bz - al		142.6 3.0, or - red, al		172.6 3.6, bz - al					
122	1,2,5,6-Tetramethylnaphthalene	118	150-60 <sup>10</sup>	156.7 red	166, bz	180.0 0.5, bz					
123	Cyclohept(fg)acenaphthene (Aceptiadene)	118-20 (subl), red, al		150 d							Maleic anhydride comp., 248-50, bz
124	1,2,7-Trimethylphenanthrene	120.1, al		148.9	169-70						
125	1',10-Dimethyl-1,2-dibenzanthracene	122.3, al		147.8, red, al							In H <sub>2</sub> SO <sub>4</sub> sol → red
126	9,10-Dimethyl-1,2-benzanthracene	122.3		112.3, blk, al di 102.6, red, al							Highly carcinogenic
127	Benz(bc)aceanthrylene	122-3, al		141.5 2.0, dk red, al		162.5 3.0 or, al					
128	1-Methylphenanthrene	123, aq al		139, yel, al	152.3, yel						
129	1,6,7-Trimethylphenanthrene	123.4, al		165.6, or di 270, red	111.2						
130	1,1'-Diacenaphthene	(a) 124, al, (b) 169, pet eth									
131	trans-Stilbene	124, al	305 <sup>720</sup>	94.5		115.20					
132	3,4-Benzfluorene	124.5, al		130.1, red, al			191.8				
133	9-Isopropylanthracene	125, al		152							
134	6-Methylnaphthanthracene	126.2 7.2, al		149.50, red-br, al			221.4 1.8 163-4, al				
135	5,8-Dimethyl-1,2-benzanthracene	131, bz - al		175, red, al							
136	8-Isopropylanthracene	132.3		118							
137	1,4,5,8-Tetramethylnaphthalene	132.3		154.6-5.4	143.4-4.2		158-9 234.5				
138	12-Methylnaphthanthracene	138, yel		115.6, red			5.0, 209.5 9.7, red, al				
139	2-Methyl-1',2'-benzpyrene	138.9, pa yel, me al, after fusing, 140.0 0.2		184.5, br, bz - lgr		211.5- 2.0, red, bz - lgr					
140	1,5-Dimethylantracene	139.40, pa yel		166.7, scar, al							
141	7-Methylnaphthanthracene	140		174, dk red			236.1- 6.5				

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

b) Solids. (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	sym-Tri-nitro-benzene derivative	2,4,7-Tri-nitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Di-nitro-phenyl sulfenyl chloride derivative	Miscellaneous
142	3,6-Dimethylphenanthrene	141, al		172 3, or -yel, me al							
143	5-Methyl-3,4-benzphenanthrene	141 4 1 9					130 6 1 4, red				
144	1,4-Dimethylchrysene	142		141, red, al							
145	1,2-Dimethylphenanthrene	142 3, al		148, or, al	153, yel, al						
146	8,10-Dimethyl-1,2-benzanthracene	146, bz - al		166, red, al							
147	1,2,8-Trimethylphenanthrene	146 7, al	210 20 <sup>13</sup>	164 5, or, al		193 0 3 5 al					
148	3-Methyl-1',2'-benzpyrene	146 7 8 1, yel, al -eth		179 5		210 5 11 0, bz -lgr					
149	9-Methyl-1',2'-benzpyrene	146 8 8 0, yel, hexane				218 5 9 5, red, bz -lgr					
150	9-Phenylfluorene	147 8, al						<i>di ca</i> 240 <i>tetra ca</i> 235 <i>d</i>			Bromide, <i>di</i> 181 2, <i>tri</i> 167 71
151	2-Methylnaphthanthracene	149 50, al		180			218 7 9 2				
152	Pyrene	149 50, pa yel	335	222, red, al 220, 227			242 3				
153	9-Methylnaphthanthracene	150 5 1 5, al		157 8			225 1 5 4				
154	4-Methylchrysene	151 0 1 5, bz - al		two forms 135 0 5 5, red, bz -lgr, 137 5 8 0, or, bz -lgr							
155	<i>trans-trans</i> -1,4-Diphenyl-1,3-butadiene ( <i>trans-trans</i> -Distyryl)	152 5	350	152 3							Maleic anhydride comp, 198-200
156	Cinnamylfluorene	155, pa yel, ac a		<i>di</i> 178 9							Tetrabromide, ca 160 d
157	5-Methylnaphthanthracene	155 9 6 9, bz - pet eth		153			235 4 5 6				
158	1,2-Benzanthracene	159-60		133			160				
159	8-Methylnaphthanthracene	160 0-0 6		166			243 2 3 6				
160	1,1'-Binaphthyl	160 5	240 4 <sup>12</sup>	145							
161	Di-1-naphthastilbene ( <i>sym</i> -Di-1-naphthylethylene)	161, pa yel, al		<i>tri</i> 210							

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS  
b) Solids. (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	sym Tri-nitro-benzene derivative	2,4,7-Tri-nitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Di-nitrophenyl sulfenyl chloride derivative	Miscellaneous
162	6-Methylchrysene	161 0 1 4, et ac -al		170 0 0 6, or, bz -al		189 8 190 6, yel, bz -al					
163	3-Methylnaphthanthracene	163 0 3 9, al		146 0 6 8			239 0 9 6				
164	2,6-Dimethyl-1,2-benzanthracene	164, ac a		199 200							
165	Cyclopentadienophenanthrene	164 5		146 7		172 3					In H <sub>2</sub> SO <sub>4</sub> sol → bl
166	10,11-Benzfluoranthene	165, 166,		194 5		220 0 0 5					
167	Hexamethylbenzene	165	264	170		174					
168	3-Methylchrysene	170 0 0 5, bz - pet-eth		164 0 4 5, grn, al							
169	Cholanthrene	170-1, 173 (subl), pa yel, bz -al		167 8, vlt -blk, bz			245 6				
170	6-Methyl-1',2'-benzpyrene	171 0 1 5, yel, bz -lgr		181 5 2 5 br bz -lgr	209 10, red bz lgr						
171	6,7-Dimethyl-1,2-benzanthracene	174, et ac		170							
172	1,2-Benzpyrene	176 5 7 5, pa yel, bz - me al	310 2 <sup>10</sup>	197 8, vlt -blk							
173	5,10-Dimethyl-1,2-benzanthracene	177, bz - al		174, red- blk, bz							
174	4,5-Benzpyrene	178-9, bz		229 30, red, bz							
175	9,10-Dimethylanthracene	180 1, al		176-7 d							
176	10-Methylnaphthanthracene	183 0- 3 6, yel, al		159 0 9 4							2,4,6-Trinitrotoluene deriv, 224 8 5 0
177	5,6-Dimethyl-1,2-benzanthracene	187 8, al		191 3, red, al							
178	2,2'-Binaphthyl	188, 181	452	184			171				Lt bl fluorescence, KMnO <sub>4</sub> → Phthalic acid, 206 8
179	1,2-Benzfluorene (Chrysofluorene)	189-90, ac a, 183-4	413, 398 400	dt 127 5, 124 6		144-5	213 5 5 5				
180	1,8-Dimethylphenanthrene	191-2, bz		151 2, yel			193 4				
181	8-Methyl-1',2'-benzpyrene	192-3, yel, bz		205, dk br, bz		233 d, red, bz					
182	Bifluorenylidene (Dibiphenyleneethylene)	194 5 (cor), red		177 8				two dt- forms 171, dk red, 170, or red			Dibromide, 312, red, bz
183	1,2,7,8-Dibenzanthracene	196, bz		212, brt red							Bl -grn fluorescence in sol

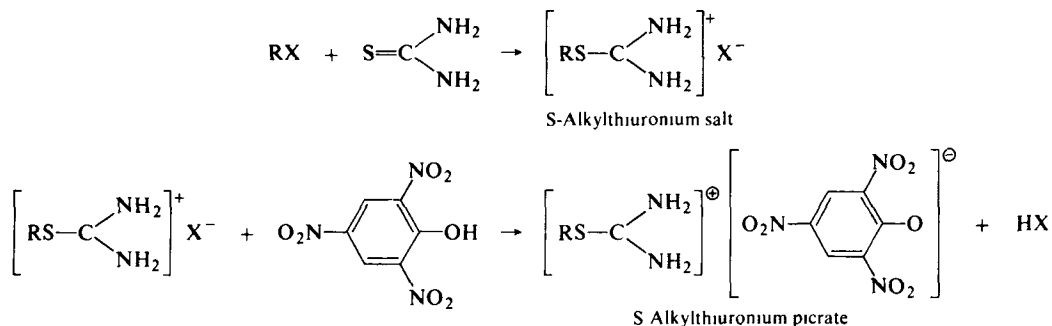
\* Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS  
b) Solids. (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	sym-Tri-nitro-benzene derivative	2,4,7-Tri-nitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Di-nitro-phenyl sulfonyl chloride derivative	Miscellaneous
184	4-Methylnaphthanthracene	197 4-8 0, al		139 40, lt red			228 2-8 8				
185	1,2,3,4-Dibenzanthracene	200 2, pa yel, ac a		207, red							In conc H <sub>2</sub> SO <sub>4</sub> sol → pa vlt-red
186	Di-2-fluorenylmethane	201 2, al						di 256 7			Na <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> → Di-2-fluorenyl ketone, 297-8, yel, ac a
187	2,3-Benzfluorene	208 9					221 2-2 0				
188	5-Methyl-1',2'-benzpyrene	215 7-6 2, yel, eth-al		207 8, vlt-blk, bz-lgr		230 1, red, bz-lgr					
189	Anthracene	216 2	340 (cor), 226 5 <sup>5a</sup>	138		164	194				D <sub>4</sub> <sup>27</sup> 1 25, Di-bromide, 122, CrO <sub>3</sub> → Anthraquinone, 273
190	11,12-Benzfluoranthene	217	480	170 1		182	236 7				
191	4-Methyl-1',2'-benzpyrene	217 5 8 0, yel		203 4, vlt-br, bz							
192	2,8-Dimethylchrysene	218, bz		171 2, bz	204, or, bz	195, yel, bz					
193	2-Methylchrysene	224 5 5 5, bz-al		143 6, yel, al							
194	6,12-Dimethylchrysene	237			207 d, bz	222					
195	1,2-Benzphenanthrene (Chrysene)	254, bz	448	273		186	248 9		214		Dibromide, 275
196	Di-2-naphthastilbene (sym-Di-2-naphthylethylene)	254 5, bz		215							
197	1-Methylchrysene	254 5 (cor), (vacuum), bz				174-6, yel, bz					
198	2,3,6,7-Dibenzphenanthrene	257, grn-yel		184, or-red							Bl fluorescence in sol, intense yel-grn in u v
199	2,3,5,6-Dibenzphenanthrene	261, grn-yel, ac a		di 213, or-red							Bl fluorescence in bz sol, grn fluorescence in u v
200	1,2,5,6-Dibenzanthracene	262, met, ac a		di 214, or							
201	Perylene	273 4					270-1 257 8				
202	Picene (1,2,7,8-Dibenzphenanthrene)	365 6, xyl	518 20								Dibromide, 295, 2,7-Dianthraquinone add comp, 299-300
203	1,2,3,4,5,6,7,8-Tetrabenzanthracene	428 9					318-9, red				
204	Coronene (Hexabenzobenzene)	438-40 (cor), yel, bz	525	>250 d, red, bz		>280 d, or, bz					

\*Derivative data given in order m p, crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE V

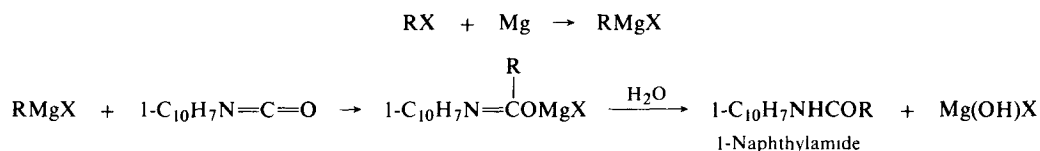
*S*-Alkylthiuronium picrate (*S*-Alkylisothiourea picrate)\*

From the alkyl halide with thiourea in 95% ethanol, followed by addition of picric acid in ethanol

*For directions and examples see* Linstead, pp 82-3, Shriner, p 245, Vogel, pp 291-2, Wild, p 43, E L Brown and N Campbell, *J Chem Soc*, 1699 (1937), W J Levy and N Campbell, *J Chem Soc*, 1442 (1939)

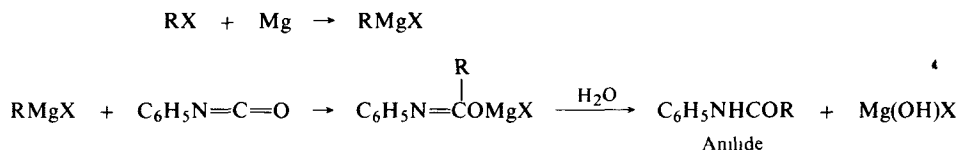
From the alkyl halide with thiourea in ethylene glycol, followed by addition of picric acid in ethanol

*See* Cheronis, p 550, H M Crosby and J B Entrikin, *J Chem Ed*, **41**, 360 (1964)

*1*-Naphthylamide ( $\alpha$ -Naphthalide)\*

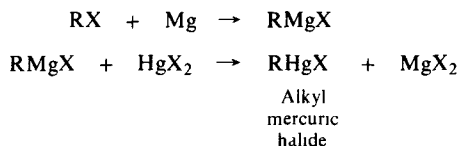
From the Grignard reagent (prepared from the alkyl halide and magnesium in dry ether) with 1-naphthylisocyanate in ether

*For directions and examples see* Cheronis, pp 551, 553 Linstead, p 83 Shriner, p 244, Vogel, pp 290-1, Wild, pp 35-37 H Gilman and M Furry, *J Amer Chem Soc*, **50**, 1214 (1928), H W Underwood and J C Gale, *J Amer Chem Soc*, **56**, 2117 (1934)

*Anilide*\*

From the Grignard reagent (prepared from the alkyl halide and magnesium in dry ether) with phenylisocyanate in ether

*For directions and examples see* Cheronis, pp 551, 554, Linstead, p 83, Shriner, p 244, Vogel, pp 290-1, Wild, pp 35-7, A M Schwartz and J R Johnson, *J Amer Chem Soc*, **53**, 1063 (1931), H W Underwood and J C Gale, *J Amer Chem Soc*, **56**, 2117 (1934)

*Alkylmercuric halide*\*

From the Grignard reagent (prepared from the alkyl halide and magnesium in dry ether) with the mercuric salt of the same halogen in ether

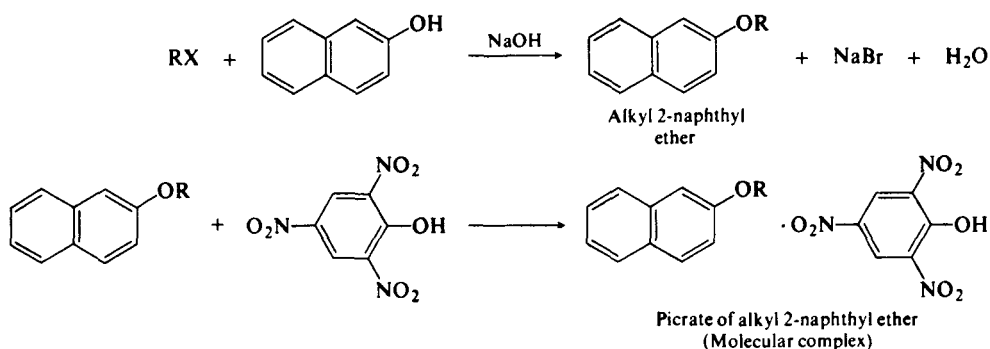
*For directions and examples see* Cheronis, pp 551, 554, Shriner, p 244, Vogel, p 291, Wild, p 38, C S Marvel, C Gauwerke and E L Hill, *J Amer Chem Soc*, **47**, 3009 (1925), E L Hill, *J Amer Chem Soc*, **50**, 167 (1928), K H Slotta and K R Jacobi, *J prakt Chem*, **120**, 249 (1929)

\*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLE V (Continued)

### Picrate of alkyl 2-naphthyl ether (Molecular complex).\*



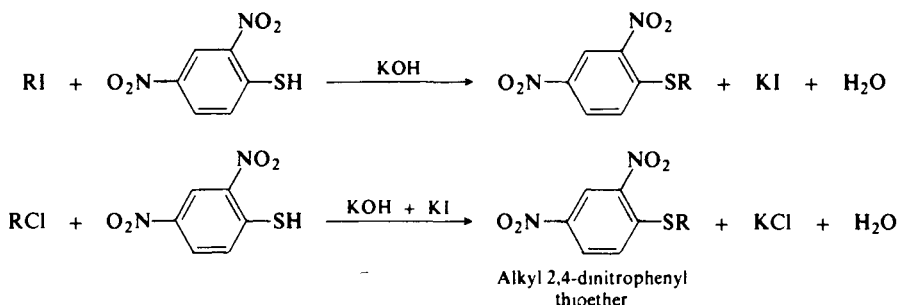
The alkyl 2-naphthyl ether is obtained from the alkyl halide with 2-naphthol in ethanolic sodium or potassium hydroxide.

For directions and examples see: Cheronis, p. 551; Linstead, p. 83; Shriner, p. 244; Vogel, p. 292; Wild, p. 44.

The picrate is obtained from the alkyl 2-naphthyl ether and picric acid in chloroform or ethanol.

See: Cheronis, p. 551; Linstead, p. 83; Vogel, p. 292; Wild, p. 44; O. L. Baril and G. A. Megrđichian, *J. Amer. Chem. Soc.*, **58**, 1415 (1936); V. H. Dermer and O. C. Dermer, *J. Org. Chem.*, **3**, 289 (1938).

### Alkyl 2,4-dinitrophenyl thioether (Alkyl 2,4-dinitrophenyl sulfide).



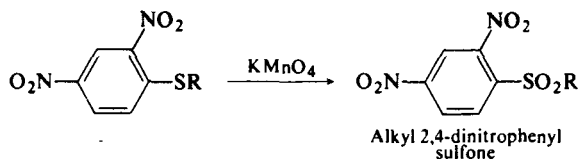
From the alkyl bromide or iodide with 2,4-dinitrothiophenol in butyl carbitol (2-(2-butoxyethoxy)ethanol) and aqueous potassium hydroxide.

For directions and examples see: Cheronis, p. 557; R. W. Bost, P. K. Starnes and E. L. Wood, *J. Amer. Chem. Soc.*, **73**, 1968 (1951).

From the alkyl chloride with 2,4-dinitrothiophenol in butyl carbitol (2-(2-butoxyethoxy)ethanol) with potassium iodide and aqueous potassium hydroxide.

See: Cheronis, p. 557; R. W. Bost, P. K. Starnes and E. L. Wood, *J. Amer. Chem. Soc.*, **73**, 1968 (1951).

### Alkyl 2,4-dinitrophenyl sulfone.



From the alkyl 2,4-dinitrophenyl thioether (prepared from the alkyl halide as above) in glacial acetic acid, with aqueous potassium permanganate.

For directions and examples see: R. W. Bost, J. O. Turner and R. D. Norton, *J. Amer. Chem. Soc.*, **54**, 1985 (1932).

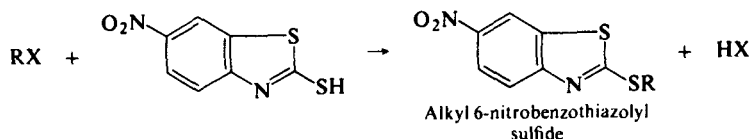
\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.



## EXPLANATIONS AND REFERENCES TO TABLE V (Continued)

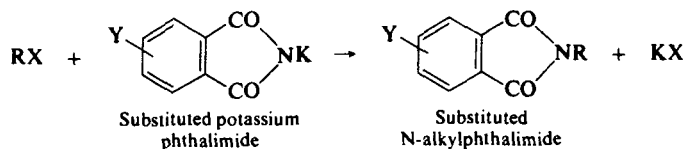
### 6-Nitro-2-mercaptobenzothiazole derivative.



From the alkyl halide (especially a dihalide) and 6-nitro-2-mercaptobenzothiazole in butyl carbitol (2-(2-butoxyethoxy)ethanol) and aqueous sodium hydroxide.

*For directions and examples see:* Cheronis, p. 557; H. B. Cutter and H. R. Golden, *J. Amer. Chem. Soc.*, **69**, 831 (1947); H. B. Cutter and A. Kreuchunas, *Anal. Chem.*, **25**, 198 (1953).

### Substituted N-alkylphthalimides.



From the alkyl halide with the potassium salt of the substituted phthalimide.

*For directions and examples see:* Wild, p. 41.

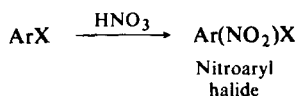
From the alkyl halide with the potassium salt of the substituted phthalimide or with the substituted phthalimide and potassium carbonate in dimethylformamide.

*See:* J. H. Billman and R. V. Cash, *J. Amer. Chem. Soc.*, **75**, 2499 (1953).

From the alkyl halide with the substituted phthalimide and potassium hydroxide in methanol-dioxane mixture.

*See:* C. H. Allen and R. V. V. Nicholls, *J. Amer. Chem. Soc.*, **56**, 1409 (1934).

### Nitro derivative.\*



From the aromatic halide with fuming and concentrated nitric acids.

*For directions and examples see:* Wild, p. 450.

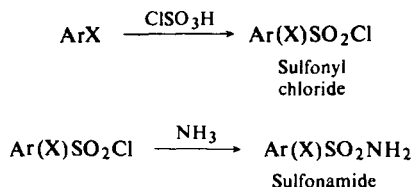
From the aromatic halide with 100% nitric acid.

*See:* Cheronis, pp. 559-561, 563.

From the aromatic halide with nitric and sulfuric acids.

*See:* Cheronis, pp. 560, 563; Vogel, p. 543.

### Sulfonamide.\*



The sulfonyl chloride is prepared from the aromatic halide and chlorosulfonic acid in chloroform or without solvent. The sulfonamide is obtained from the sulfonyl chloride with concentrated ammonia or dry ammonium carbonate.

*For directions and examples see:* Cheronis, pp. 564, 638, 639; E. H. Huntress and F. H. Carten, *J. Amer. Chem. Soc.*, **62**, 511 (1940).

*NOTE:* For additional information regarding directions and examples for the derivatization of aromatic halides (through the above reactions or additional ones, e.g., side-chain oxidation) see explanations and references to Table IV, pp. 32, 33, 34.

\*Derivatives recommended for first trial.

**WARNING:** This is not an instruction manual. References should be consulted for the preparation of derivatives.

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**

**A) Alkyl and cycloalkyl halides 1. Chlorides**

**a) Liquids (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	$n_D^{20}$	$D_4^{20}$	S-Alkyl thiuronium picrate	1 Naphthyl amide	Anilide	Alkyl mercuric halide	Picrate of 2-naphthyl ether	2,4-Dinitrophenyl thioether	2,4-Dinitrophenyl sulfone	Miscellaneous
1	Methyl chloride	-24			224	160	114	167		128	185, 189	Methyl-2-naphthyl ether, 70
2	Vinyl chloride	-14			104							Polymerizes to solid on irradiation
3	Ethyl chloride	13		0.917 <sub>8</sub>	188	126	104	192	104	115	156, 160	
4	Isopropyl chloride	36.5	1.378	0.859	196, 148		103		95			
5	1-Chloropropene	37					114					
6	Allyl chloride	44.5	1.416	0.940	155		114		99			3-Nitrophthalimide deriv., 100-1
7	n-Propyl chloride	46.5	1.388	0.889	181, 176	121	92	147	81	84	126	
8	tert-Butyl chloride	51	1.386	0.846	160-1	147	128	122-3				Heating with maleic anhydride and boiling the adduct in water → 4-chloro-1,2,3,6-tetrahydrophthalic acid, 173-5
9	Chloroprene	59	1.458	0.9583								
10	sec-Butyl chloride	68	1.397	0.874	190, 166	129	108	30.5	86	66	120	
11	Isobutyl chloride	69	1.398	0.881	174	125	109		85	76	105	
12	Methallyl chloride (3-Chloro-2-methyl-1-propene)	72	1.4340	0.9475								Phthalimide deriv., 89-90
13	n-Butyl chloride	78	1.402	0.886	180, 177	112	63	128	67	66	92	
14	Neopentyl chloride	85		0.879			130-1	117-8				
15	tert-Amyl chloride	86	1.405	0.865		138	92					
16	3-Chloro-1-pentene	93-4	1.4254	0.8978								Phthalimide deriv., 78-9
17	DL-3-Chloro-2-methyl-1-butene	94	1.4304	0.9088								Br <sub>2</sub> → dibromo deriv., 197-8
18	Trimethylvinyl chloride (3-Chloro-2-methyl-2-butene)	94	1.4320	0.925 (0.905)								Br <sub>2</sub> in ether → dibromo deriv., 197
19	DL-2-Chloropentane	97	1.4079	0.8695		102.3	94.6					
20	3-Pentyl chloride (3-Chloropentane)	97	1.4082	0.8723		117-8	127, 122					
21	Isoamyl chloride	100	1.409	0.872	179, 173	111	108	86	94	80	124	
22	n-Amyl chloride (n-Pentyl chloride)	106	1.412	0.882	154	112	96	110	67	80	83	
23	1-Chloro-2-pentene	109-10	1.435 <sup>21</sup>	0.908 <sup>21, 5</sup>								Phthalimide deriv., 69-70
24	2-Chloro-2-methylpentane	110.3	1.4126	0.863		116-8	71-4					
25	3-Chloro-2,2-dimethylbutane (Pinacolyl chloride)	112	1.4181	0.8767				89-90				
26	Cyclopentyl chloride	114-5	1.4510	1.005				108				
27	4-Chloro-2,2-dimethylbutane	115	1.4160	0.8670			138-9	133				
28	3-Chloro-3-methylpentane	115-7	1.421	0.89			87-8					
29	2-Chloro-2,3-dimethylbutane	117-9		0.8769 <sup>22</sup>								Carbonation of Grignard and conversion of acid to amide, 125-7. Br <sub>2</sub> → 2,3-dibromo deriv., 166-8 (173-4)
30	3-Hexyl chloride (3-Chlorohexane)	123	1.4163	0.870 <sub>20</sub>								Grignard reagent + O <sub>2</sub> → 3-hexanol → 3-hexanone, 2,4-Dinitrophenylhydrazone, 147-8 Semicarbazone, 110-11

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**

**A) Alkyl and cycloalkyl halides 1. Chlorides**

**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	$n_D^{20}$	$D_4^{20}$	S Alkyl thiuronium picrate	1 Naphthyl amide	Anilide	Alkyl mercuric halide	Picrate of 2 naphthyl ether	2,4-Di-nitrophenyl thio ether	2,4-Di-nitrophenyl sulfone	Miscellaneous
31	<b>2-Hexyl chloride (2-Chlorohexane)</b>	123.4	1.4142 <sup>21</sup>	0.8694 <sup>21</sup>			91-2					
32	<b>1-Chloro-2-ethylbutane</b>	125-7	1.4230	0.8914			81.2 83-4					
33	<b>3-Chloro-2,2,3-trimethylbutane</b>	133										Carbonation of Grignard → acid, 80
34	<i>n</i> -Hexyl chloride	133	1.420	0.878	157	106	69	125		74	97	
35	<b>Cyclohexyl chloride</b>	143	1.462	0.989		188	146					6-Nitro-2-mercaptobenzothiazole deriv 100-1.2 sulfone, 189
36	<b>5-Chloro-2,3-dimethylpentane</b>	152	1.4299	0.8825			80.1					
37	<i>n</i> -Heptyl chloride	159	1.426	0.877	142	95	57	120		82	101	
38	<b>Benzyl chloride</b>	179	1.539	1.100	188	166	117	104	123	130	178, 182	Quaternary salt with dimethyl aniline, 110
39	<i>n</i> -Octyl chloride	180, 184	1.431	0.875	134	91	57	115		78	98	
40	$\beta$ -Phenylethyl chloride	190					97		84			
41	<b>4-Methylbenzyl chloride</b>	192	1.5380	1.0512								Phthalimide, 120.117 Carbonation of Grignard → 4-tolylacetic acid, 92
42	$\alpha$ -Phenylethyl chloride	195					133					
43	<b>3-Methylbenzyl chloride</b>	195-6	1.5327 <sup>25</sup>	1.064 <sup>20</sup>								Phthalimide deriv., 117-8, Carbonation of Grignard → 3-tolylacetic acid, 61
44	<b>2-Methylbenzyl chloride</b>	197.9										Phthalimide deriv., 148-9, Heating with pyridine → alkyl pyridinium chloride 183
45	$\beta$ -Chlorostyrene	197-9	1.571 <sup>25</sup>	1.109								Br <sub>2</sub> in chl → dibromo deriv., 32, Oxid → benzoic acid, 122
46	<i>n</i> -Nonyl chloride	202	1.434	0.870	131					86	92	
47	<b>2-Chlorobenzyl chloride</b>	213-4										5-Nitro deriv. 66 Carbonation of Grignard → 2-chlorophenylacetic acid, 94-5
48	<b>4-Chlorobenzyl chloride</b>	214, 222					166					Oxid → 4-chlorobenzoic acid, 242
49	<b>3-Chlorobenzyl chloride</b>	216		1.2695 <sup>15</sup>								Oxid → 3-chlorobenzoic acid, 158, 155, Heating with 2,4-dichlorophenol in toluene → 2-(3-chlorobenzyl)-4,6-dichlorophenol, 59-60
50	<i>n</i> -Decyl chloride	223	1.437	0.868	137							
51	<b>4-Isopropylbenzyl chloride</b>	226-9										Carbonation of Grignard → acid, 52
52	<i>n</i> -Undecyl chloride ( <i>n</i> -Hendecyl chloride)	241	1.440	0.868	139							
53	<i>n</i> -Dodecyl chloride (Lauryl chloride)	243-4	1.4425	0.8673				114				Refluxed with pyridine → alkyl pyridinium chloride, 92
54	<b>Cetyl chloride (Hexadecyl chloride)</b>	286 d			155			102				3-Nitrophthalimide deriv., 101, Alkyl saccharin deriv., 98

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**

**A) Alkyl and cycloalkyl halides 1. Chlorides**

**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point, °C	S-Alkyl thiuronium picrate	1-Naphthyl amide	Anilide	Alkyl mercuric halide	Picrate of 2-naphthyl-ether	2,4-Di-nitro-phenyl thio-ether	2,4-Di-nitro-phenyl sulfone	Miscellaneous
1	<b>1,3-Bis(chloromethyl)benzene</b> ( <i>m</i> -Xylylene dichloride)	32-4	250-5								Diphthalimide deriv , 237
2	<b>4-Bromobenzyl chloride</b>	36-8, 50	236	219							Oxid → 4-bromobenzoic acid, 251
3	<b>2,4,6-Trimethylbenzyl chloride</b>	37	130 <sup>22</sup>								Hydrolysis → 2,4,6-trimethylbenzyl alcohol, 88-9, Phthalimide deriv , 209-10
4	<b>2,6-Dichlorobenzyl chloride</b>	39-40									Carbonation of Grignard → 2,6-dichlorophenylacetic acid, 157 8
5	<b>1-Chloro-2,2,3,3-tetramethylbutane</b>	52-3					170-1				Grignard treated with O <sub>2</sub> at -5 → carbinol, 149-50
6	<b>1,2-Bis(chloromethyl)benzene</b> ( <i>o</i> -Xylylene dichloride)	54-5	239-41								Oxid → phthalic acid, 200-6
7	<b>4-Nitrobenzyl chloride</b>	71									Oxid → 4-nitrobenzoic acid, 241
8	<b>1,4-Bis(chloromethyl)benzene</b> ( <i>p</i> -Xylylene dichloride)	98-100	240-5								Heating with benzyl alcohol + KOH → dibenzyl ether, 67, Boiling with Pb(NO <sub>3</sub> ) <sub>2</sub> → terephthaldehyde, 115
9	<b>Triphenylmethyl chloride</b> (Trityl chloride)	113									Boiling with H <sub>2</sub> O → triphenyl carbinol, 162

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**

**A) Alkyl and cycloalkyl halides 2. Bromides**

**a) Liquids (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	S-Alkyl thuronium picrate	l Naphthyl amide	Anilide	Alkyl mercuric halide	Picrate of 2-naphthyl ether	2,4-Dinitro phenyl thioether	2,4-Dinitro phenyl sulfone	Miscellaneous
1	Methyl bromide	3.5			224	160	114	172, 160		128	185, 189	
2	Vinyl bromide	16					104					
3	Ethyl bromide	38	1.425	1.460	188	126	104	193, 198	104	115	156, 160	
4	1-Bromopropene	60	1.452	1.4133			114					
5	Isopropyl bromide	60	1.425	1.314	196, 148		103	93	92	95	140	
6	Allyl bromide	71	1.46545	1.398	155		114		99	71		
7	n-Propyl bromide	71	1.4341	1.353	181, 177	121	92	138	75	84	126	
8	tert-Butyl bromide	72.3		1.211		147	128					
9	Isobutyl bromide	91	1.435	1.253	174, 167	125	109	55	84	76	105	
10	sec-Butyl bromide	91	1.437	1.256	190, 166	129	108	39	85	66	120	
11	n-Butyl bromide	101	1.440	1.274	180, 177	112	63	136, 129	67	66	92	
12	tert-Amyl bromide	108	1.442	1.198, <sup>18</sup>		138	92					
13	Neopentyl bromide	109		1.225			126					
14	DL-2-Pentyl bromide	117, 113	1.442	1.212		102, 3	93					
15	3-Pentyl bromide	118	1.443	1.211			124					
16	Isoamyl bromide	120-1	1.442	1.213	179, 173	111	108	80	94	80	124	
17	n-Amyl bromide (n-Pentyl bromide)	129	1.445	1.219	154	112	96	127, 122	67	80	83	
18	Cyclopentyl bromide	137	1.489	1.387								
19	2-Hexyl bromide (2-Bromohexane)	146	1.4832 <sup>25</sup>	1.1658			91-2					
20	n-Hexyl bromide	155, 157	1.448	1.175	157	106	69	127, 119		74	97	
21	Cyclohexyl bromide	165	1.495	1.336		188	146	153				
22	n-Heptyl bromide	180, 174	1.451	1.140	142	95	57	118		82	101	
23	Benzyl bromide	198	1.438	1.438	188	166	117	119	123	130	178, 182	
24	n-Octyl bromide	201, 204	1.453	1.112	134	91	57	109		78	98	
25	α-Phenylethyl bromide	205					133					
26	β-Phenylethyl bromide	218	1.556	1.359			97	169	84			
27	n-Nonyl bromide	220	1.454	1.090	131			109		86	92	
28	β-Bromostyrene	221				217	115	91				
29	n-Dodecyl bromide (Lauryl bromide)	130 <sup>6</sup>	1.458	1.038				108				
30	n-Tetradecyl bromide	179 <sup>20</sup>	1.460	1.017						94	104	m p 5

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**

**A) Alkyl and cycloalkyl halides 2. Bromides**

**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point, °C	S-Alkyl thiuronium picrate	1-Naphthyl amide	Anilide	Alkyl mercuric halide	Picrate of 2-naphthyl ether	2,4-Di-nitro-phenyl thio-ether	2,4-Di-nitro-phenyl sulfone	Miscellaneous
1	<i>n</i> -Hexadecyl bromide (Cetyl bromide)	14	201*	155, 137			101 2		95	105	$n_D^{20}$ 1.462, $D_4^{20}$ 1.001
2	<b>2-Bromobenzyl bromide</b>	31		222							CrO <sub>3</sub> → 2-bromobenzoic acid, 150
3	<b>3-Bromobenzyl bromide</b>	41		205							CrO <sub>3</sub> → 3-bromobenzoic acid, 155
4	<b>2-Nitrobenzyl bromide</b>	46-7									Oxid → 2-nitrobenzoic acid, 146-8
5	<b>4-Chlorobenzyl bromide</b>	51		194							CrO <sub>3</sub> → 4-chlorobenzoic acid, 242
6	<b>3-Nitrobenzyl bromide</b>	58-9									Oxid → 3-nitrobenzoic acid, 141
7	<b>4-Bromobenzyl bromide</b>	62		219							CrO <sub>3</sub> → 4-bromobenzoic acid, 251
8	<b>4-Nitrobenzyl bromide</b>	99									Oxid → 4-nitrobenzoic acid, 240

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**

**A) Alkyl and cycloalkyl halides 3. Iodides**

**a) Liquids (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	$n_D^{20}$	$D_4^{20}$	S-Alkyl thuronium picrate	1-Naphthyl amide	Anilide	Alkyl mercuric halide	Picrate of 2-naphthyl ether	2,4-Dinitrophenyl thioether	2,4-Dinitrophenyl sulfone	Miscellaneous
1	Methyl iodide	43	1.532	2.282	224	160	114	152, 145	117	128	185, 189	
2	Vinyl iodide	56					104					
3	Ethyl iodide	72	1.514	1.940	188	126	104	186, 182	104	115	156, 160	
4	Isopropyl iodide	90	1.499	1.703	196, 148		103		92	95	140	
5	<i>n</i> -Propyl iodide	102-3	1.505	1.743	181, 176	121	92	113	75	84	126	
6	Allyl iodide	103	1.578	1.777	155	121	114	112	99			
7	<i>tert</i> -Butyl iodide	103, 98			188	147	128					
8	<i>sec</i> -Butyl iodide	120	1.499	1.592	190, 166	129	108		85	66	120	
9	Isobutyl iodide	120	1.496	1.602	174, 167	125	109	72	84	76	105	
10	<i>tert</i> -Amyl iodide	128		1.479		138	92					
11	<i>n</i> -Butyl iodide	130	1.499	1.616	180, 177	112, 110	63	117	67	66	92	
12	2-Pentyl iodide	142	1.496	1.510			93					
13	3-Pentyl iodide	142	1.497	1.511			124					
14	Isoamyl iodide	148	1.493	1.503	179, 173	111	108	122	94	80	124	
15	<i>n</i> -Amyl iodide ( <i>n</i> -Pentyl iodide)	155	1.496	1.512	154	112	96	110	67	80	83	
16	Cyclopentyl iodide	166-7	1.5447	1.7096								
17	Cyclohexyl iodide	179, sl d		1.626 $\frac{1}{3}$		188	146					
18	<i>n</i> -Hexyl iodide	179	1.493	1.437	157	106	69	110		74	97	
19	<i>n</i> -Heptyl iodide	204	1.490	1.373	142	95	57	103		82	101	
20	<i>n</i> -Nonyl iodide	220			131					86	92	
21	<i>n</i> -Octyl iodide	225-6	1.489	1.330	134					78	98	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**

**A) Alkyl and cycloalkyl halides 3. Iodides**  
**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point, °C	S-Alkyl thiuronium picrate	1-Naphthyl amide	Anilide	Alkyl mercuric halide	Picrate of 2-naphthyl ether	2,4-Dinitrophenyl thioether	2,4-Dinitrophenyl sulfone	Miscellaneous
1	<i>n</i> -Hexadecyl iodide (Cetyl iodide)	22		155, 137			82		95	105	
2	Benzyl iodide	24		188	166	117		123	130	178, 182	

\*Derivative data given in order m p , crystal color, solvent from which crystallized



**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**B) Dihalides and polyhalides (non-aromatic)**  
**1. Fluorides (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point °C	$n_D^{20}$	$D_4^{20}$	Miscellaneous
1	Perfluorocyclopentane	22		1.648 <sub>4</sub> <sup>25</sup>	m p 10
2	1,3-Difluoropropane	41.2	1.3190 <sup>26</sup>	1.0057 <sub>4</sub> <sup>25</sup>	
3	Perfluorocyclohexane	50			m p 49
4	Perfluoro- <i>n</i> -hexane	57	1.2515 <sup>22</sup>	1.6995 <sub>4</sub> <sup>25</sup>	
5	Perfluoro-2-methylpentane	58	1.2564 <sup>22</sup>	1.7326	
6	Perfluoro- <i>n</i> -heptane	84	1.2770	1.801 <sub>4</sub> <sup>25</sup>	
7	Perfluoro- <i>n</i> -nonane	127	1.2865 <sup>25</sup>	1.860 <sub>4</sub> <sup>25</sup>	
8	Perfluoro- <i>n</i> -decane	150	1.2890 <sup>25</sup>	1.873 <sub>4</sub> <sup>25</sup>	m p 36
9	Perfluoro- <i>n</i> -undecane (Perfluoro- <i>n</i> -hendecane)	161	1.2960 <sup>25</sup>	1.919 <sub>4</sub> <sup>25</sup>	m p 57

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**B) Dihalides and polyhalides (non-aromatic)**  
**2. Chlorides a) Liquids (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	$n_D^{20}$	$D_4^{20}$	Miscellaneous
1	Dichloromethane (Methylene chloride)	41	1.4237	1.336	6-Nitro-2-mercaptobenzothiazole deriv., 232-3, Di-(2-naphthyl) ether, 133 S-Alkyl bis-(thiuronium picrate), 267
2	<i>trans</i> -1,2-Dichloroethylene	48	1.452	1.2569	Br <sub>2</sub> → dibromo deriv., 190-5
3	1,1-Dichloroethane	57	1.4164	1.175	1,1-Di-(1-naphthyl) ether, 117
4	<i>cis</i> -1,2-Dichloroethylene	60	1.4428 <sup>45</sup>	1.282	Br <sub>2</sub> → dibromo deriv., 190-5
5	Chloroform	61	1.446	1.489	Gives carbylamine test with primary amines
6	2,2-Dichloropropane	70	1.4117	1.093	
7	1,1,1-Trichloroethane	74	1.4380	1.349	
8	Carbon tetrachloride	77	1.4630	1.595	
9	Ethylene dichloride (1,2-Dichloroethane)	84	1.4443	1.256	1,2-Di-(2-naphthyl) ether, 217
10	1,1,2-Trichloroethylene	87	1.4773	1.464	HgO + NaOEt + KCN in al shaken 1 hr at 40-60 → mercury bis-(trichloroethylene), Hg(-CCl=CCl <sub>2</sub> ) <sub>2</sub> , 83, eth
11	1,2-Dichloropropane	96	1.4388	1.155	1,2-Di-(2-naphthyl) ether, 152, 1,2-Diphenyl ether, 32
12	1-Bromo-2-chloroethane	106-7			6-Nitro-2-mercaptobenzothiazole deriv., 202-3 Di-(2-naphthyl) ether, 217
13	1,1,2-Trichloroethane	114	1.4707	1.443	
14	1,1,2,2-Tetrachloroethylene (Perchloroethylene)	121	1.5055	1.623	With paraformaldehyde + conc H <sub>2</sub> SO <sub>4</sub> → α,α-dichloro-β-hydroxypropionic acid 88-9
15	1,2-Dichlorobutane	123-4	1.440		6-Nitro-2-mercaptobenzothiazole deriv., 164-5
16	1,3-Dichloropropane	125	1.449	1.189 <sup>18</sup> 1.177 <sup>27</sup>	1,3-Di-(1-naphthyl) ether, 103-4 1,3-Di-(2-naphthyl) ether, 148-9 1,3-Diphenyl ether, 60
17	1,3-Dichloro-2-methylpropane	135-6	1.4627 <sup>19</sup>	1.131 <sup>20</sup>	
18	1-Bromo-3-chloropropane	143-4	1.4861	1.594	1,3-Di-(1-naphthyl) ether, 103-4 1,3-Di-(2-naphthyl) ether, 148-9 1,3-Diphenyl ether, 60
19	1,1,2,2-Tetrachloroethane	146	1.4942	1.600	
20	1,2,3-Trichloropropane	158	1.4585	1.417	
21	Pentachloroethane	161	1.504	1.681	
22	Benzalchloride	207, 214	1.5515	1.295 <sup>16</sup>	Oxid → benzoic acid, 122, Hydrolysis → benzaldehyde, 2,4-Dinitrophenylhydrazone 237, Semicarbazone, 222
23	Benzotrichloride	221		1.374 <sup>17</sup> 1.399 <sup>15</sup>	Hydrolysis → benzoic acid, 122
24	2-Chlorobenzalchloride (2-Chlorobenzylidene chloride)	228-9	1.5670 <sup>18</sup>	1.399 <sup>15</sup>	Oxid → 2-chlorobenzoic acid, 141 Hydrolysis → 2-chlorobenzaldehyde, 2,4-dinitrophenylhydrazone, 213-209
25	3-Chlorobenzalchloride (3-Chlorobenzylidene chloride)	237-40			Oxid → 3-chlorobenzoic acid, 158 Hydrolysis → 3-chlorobenzaldehyde, 2,4-dinitrophenylhydrazone, 256-248
26	4-Chlorobenzalchloride (4-Chlorobenzylidene chloride)	237			Oxid → 4-chlorobenzoic acid, 240, Hydrolysis → 4-chlorobenzaldehyde, 47 2,4-dinitrophenylhydrazone, 265

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**B) Dihalides and polyhalides (non-aromatic) 2. Chlorides**  
**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point °C	Boiling point, °C	Miscellaneous
1	<b>3,4-Dichlorobenzotrichloride</b>	26		Hydrolysis → 3,4-Dichlorobenzoic acid, 202
2	<b>DDT (2,2-Bis-(4-chlorophenyl)-1,1,1-trichloroethane)</b>	108	260	Heating with Cl <sub>2</sub> + trace PCl <sub>5</sub> in CCl <sub>4</sub> → 1,1,1,2-tetrachloro deriv, 91-2, Nitration → nitro deriv, 148, AlCl <sub>3</sub> + benzene → 1,1,2,2-tetraphenylethane, 211
3	<b>γ-Benzene hexachloride (Gammexane, 666)</b>	112		
4	<b>α-Benzene hexachloride</b>	157	288	Heat above m p → HCl + 1,2,4-trichlorobenzene, 17, b p 213, mononitro deriv, 56, dinitro, 103
5	<b>Hexachloroethane</b>	187 subl	185	
6	<b>β-Benzene hexachloride</b>	310		Unreactive to boiling pyridine, Unattacked by boiling HNO <sub>3</sub> or H <sub>2</sub> SO <sub>4</sub>

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**B) Dihalides and polyhalides (non-aromatic)**  
**3. Bromides a) Liquids (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	$n_D^{20}$	$D_4^{20}$	Miscellaneous
1	<b>Dibromomethane</b> (Methylene bromide)	98-9	1 538	2 496	6-Nitro-2-mercaptobenzothiazole deriv , 232 3, S-Alkyl <i>bis</i> -(thiuronium picrate), 267
2	<b>1,1-Dibromoethane</b>	112	1 5128	2 055	6-Nitro-2-mercaptobenzothiazole deriv , 145 6 1,1-Di-(1 naphthyl) ether, 117
3	<b>1,2-Dibromoethane</b>	132	1 5379	2 179	m p 10, 6-Nitro-2-mercaptobenzothiazole deriv 201 2 1,2-Di-(2-naphthyl) ether 217
4	<b>DL-1,2-Dibromopropane</b>	141-2	1 5203	1 933	6-Nitro-2-mercaptobenzothiazole, 194 5, 1 2-Di-(2-naphthyl) ether, 152, 1,2-Diphenyl ether, 32
5	<b>1,2-Dibromo-2-methylpropane</b>	149	1 512	1 783	
6	<b>1,2-Dibromo-1-butene</b>	150		1 887	
7	<b>Bromoform</b>	150-1	1 598	2 890 <sup>o</sup>	m p 8
8	<b>1,3-Dibromopropene</b>	156	1 538 <sup>25</sup>	2 097 <sup>o</sup>	
9	<b>1,1-Dibromo-2-methylpropene</b>	156 7	1 530	1 866 <sup>20</sup>	
10	<b>2,3-Dibromobutane</b>	157	1 515	1 792	
11	<b>1,2-Dibromobutane</b>	166		1 820	6-Nitro-2-mercaptobenzothiazole deriv , 164 5
12	<b>1,3-Dibromopropane</b>	167 8	1 523	1 982	1,3-Di-(1-naphthyl) ether, 103-4 1 3 Di-(2-naphthyl) ether 148 9 1,3-Diphenyl ether, 60
13	<b>1,3-Dibromo-2-butene</b>	168-9	1 548	1 877	
14	<b>1,3-Dibromobutane</b>	174	1 507	1 820 <sup>o</sup>	
15	<b>1,1,2-Tribromoethane</b>	189	1 5933	2 6211	
16	<b>1,4-Dibromobutane</b>	197-8		1 847 <sup>o</sup>	<i>p</i> -toluidine (3 moles) $\xrightarrow{\text{heat}}$ N-4 tolylpyrrolidine, 42 dil al
17	<b>1,2,3-Tribromopropane</b>	220	1 582	2 402	
18	<b>1,5-Dibromopentane</b>	221	1 514 <sup>15</sup>	1 694 <sup>25</sup>	6-Nitro-2-mercaptobenzothiazole deriv , 132 3 S-Alkyl <i>bis</i> -(thiuronium picrate) 247
19	<b>1,1,2,2-Tetrabromoethane</b>	243-4	1 638	2 967	
20	<b>1,8-Dibromooctane</b>	270-2	1 501 <sup>15</sup>	1 468 <sup>15</sup>	m p 15-6, S-Alkyl <i>bis</i> -(thiuronium picrate), 214
21	<b>1,9-Dibromononane</b>	285-8		1 415 <sup>15</sup>	m p -2 5, S-Alkyl <i>bis</i> -(thiuronium picrate), 193

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**B) Dihalides and polyhalides (non-aromatic)**  
**3. Bromides b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point °C	Boiling point °C	Miscellaneous
1	<b>1,7-Dibromoheptane</b>	42	263	S-Alkyl bis-(thiuronium picrate), 208
2	<b>Carbon tetrabromide</b>	92	190	

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**B) Dihalides and polyhalides (non-aromatic)**  
**4. Iodides a) Liquids (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	$n_D^{20}$	$D_4^{20}$	Miscellaneous
1	Di-iodomethane (Methylene iodide)	181	1.7425	3.325	6-Nitro-2-mercaptobenzothiazole deriv., 232-3, Di-(2-naphthyl) ether, 133, S-Alkyl bis-(thiuronium picrate), 267
2	1,3-Di-iodopropane	224	1.6423	2.5755	1,3-Di-(1-naphthyl) ether, 103-4, 1,3-Di-(2-naphthyl) ether, 148-9, 1,3-Diphenyl ether, 60

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**

**B) Dihalides and polyhalides (non-aromatic)**

**4. Iodides b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point °C	Boiling point, °C	Miscellaneous
1	<b>1,2-Di-iodoethane</b>	81		6-Nitro-2-mercaptobenzothiazole deriv , 202 3, 1,2-Di-(2-naphthyl) ether, 217
2	<b>Iodoform</b>	119		Comp with quinoline, 65

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**C) Aryl halides 1. Fluorides (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Nitro derivative		Sulfonamide		Miscellaneous
						M P	Position of nitro groups	M P	Position of sulfonamide group	
1	<b>1,3-Difluorobenzene</b>	82		1.4404 <sup>18</sup>	1.1473 <sup>25</sup>	74	1,3			
2	<b>Fluorobenzene</b>	87		1.466	1.024			125	4	
3	<b>1,4-Difluorobenzene</b>	88		1.4423 <sup>18</sup>	1.1632 <sup>25</sup>					Boiling with NaOH → 4-fluorophenol, 48, b p 186-8, n <sub>D</sub> <sup>20</sup> 1.5010, D <sub>4</sub> <sup>20</sup> 1.1889
4	<b>1,2-Difluorobenzene</b>	92	-34	1.4451 <sup>18</sup>	1.1496 <sup>25</sup>					
5	<b>2-Fluorotoluene</b>	114						105	5	Oxid → 2-fluorobenzoic acid, 127
6	<b>3-Fluorotoluene</b>	116						174	6	Oxid → 3-fluorobenzoic acid, 124
7	<b>4-Fluorotoluene</b>	117		1.496	0.998			141	2	Oxid → 4-fluorobenzoic acid, 182
8	<b>1-Fluoronaphthalene</b>	214		1.594	1.134					Picrate, 113
9	<b>2-Fluoronaphthalene</b>		60							Picrate, 101

\*Derivative data given in order m p, crystal color, solvent from which crystallized



TABLE V. ORGANIC DERIVATIVES OF HALIDES

\* C) Aryl halides 2. Chlorides a) Liquids (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Nitro derivative		Sulfonamide		Miscellaneous
						M P	Position of nitro groups	M P	Position of sulfonamide group	
1	Chlorobenzene	132		1.525	1.107	52	2,4	144	4	2,4-Dinitrobenzenesulfonyl chloride adduct, 123-4
2	2-Chlorotoluene	159		1.524	1.082	63	3,5	128	5	Oxid → 2-chlorobenzoic acid, 141
3	3-Chlorotoluene	162		1.521	1.072	91	4,6	185	6	Oxid → 3-chlorobenzoic acid, 158
4	4-Chlorotoluene	162	7	1.521	1.071	38	2	143	2	Oxid → 4-chlorobenzoic acid, 240
5	1,3-Dichlorobenzene	173		1.546	1.288	103	4,6	182	6	
6	1-Chloro-2-ethylbenzene	178, 180		1.5218	1.057					Oxid → 2-chlorobenzoic acid, 141
7	1,2-Dichlorobenzene	179		1.552	1.305	110	4,5	135, 140	4	
8	1-Chloro-3-ethylbenzene	184		1.5199	1.053					Oxid → 3-chlorobenzoic acid, 158
9	1-Chloro-4-ethylbenzene	184, 180-1		1.5175	1.045					Oxid → 4-chlorobenzoic acid, 240
10	2-Chloro-1,4-dimethylbenzene	184-5	2	1.059 <sup>20</sup>		77, 101	5, 5,6	155	5	Sulfonyl chloride, 50
11	1-Chloro-2-vinylbenzene (o-Chlorostyrene)	189		1.5649	1.100					Polymerizes on heating with benzoyl peroxide
12	1-Chloro-2,3-dimethylbenzene	190								Oxid → 3-chloro-2-methylbenzoic acid, 159
13	1-Chloro-2-isopropylbenzene	191		1.5168	1.0341					Oxid → 2-chlorobenzoic acid, 141
14	1-Chloro-2,4-dimethylbenzene	192, 187		1.5230 <sup>25</sup>	1.0598 <sup>20</sup>	42	6	195	6	Oxid $\xrightarrow{\text{CrO}_3/\text{H}_2\text{SO}_4}$ 4-chloro-3-methylbenzoic acid, 209-10. Oxid $\xrightarrow{\text{aq KMnO}_4}$ 4-chloroisophthalic acid, 294-5
15	1-Chloro-4-vinylbenzene (p-Chlorostyrene)	192		1.5660	1.0868					Polymerizes on heating with peroxide
16	1-Chloro-3,4-dimethylbenzene	194-5	-6	1.069 <sup>13</sup>		63	5	207	5	Cl <sub>2</sub> $\xrightarrow{\text{Fe}}$ 1,2-dichloro-4,5-dimethylbenzene, 76
17	1-Chloro-4-isopropylbenzene (p-Chlorocumene)	198		1.5117	1.0208			91		Oxid → 4-chlorobenzoic acid, 240
18	2,6-Dichlorotoluene	199		1.5510	1.2686	50, 121	3, 3,5			Chlorosulfonic acid in chl → 3-sulfonyl chloride 54, 6, 60. Oxid → 2,6-dichlorobenzoic acid 139
19	2,5-Dichlorotoluene	199	4-5	1.2535 <sup>20</sup>		50, 100-1	4, 4,6			Oxid $\xrightarrow{\text{dil HNO}_3}$ 2,5-dichlorobenzoic acid, 154
20	2,4-Dichlorotoluene	200		1.549	1.249	104	3,5			Oxid → 2,4-dichlorobenzoic acid, 164
21	3,5-Dichlorotoluene	201				61, 99-100	2, 2,6	168, 9	2	Oxid → 3,5-dichlorobenzoic acid, 188
22	2-Chloro-1,3,5-trimethylbenzene	204-6		1.5212 <sup>30</sup>	1.0337 <sup>30</sup>	178	4,6	165-6		Oxid $\xrightarrow{\text{aq KMnO}_4}$ 2-chlorobenzene tricarboxylic acid, 285 (anh), 278 (hyd)
23	2,3-Dichlorotoluene	207		1.5511		51, 71-2	4, 4,6			Oxid $\xrightarrow{\text{alk KMnO}_4}$ 2,3-dichlorobenzoic acid, 163
24	3,4-Dichlorotoluene	209		1.5471	1.2526	63, 91-2	6, 2,6			Oxid → 3,4-dichlorobenzoic acid, 206
25	1,2,4-Trichlorobenzene	213	17			56, 103	5, 3,5	>200		Sulfonyl chloride, 31-4
26	2-Chloro-4-isopropyl-1-methylbenzene (2-Chloro-p-cymene)	217		1.5178 <sup>17</sup>	1.015 <sup>17</sup>	109-10	5,6			Boiling with dil HNO <sub>3</sub> → 3-chloro-4-methylbenzoic acid, 196
27	3-Chloro-4-isopropyl-1-methylbenzene (3-Chloro-p-cymene)	217		1.5179 <sup>18</sup>	1.018 <sup>18</sup>	102-3, 106	2,6			
28	1-Chloronaphthalene	259		1.633	1.191	180	4,5			Picrate, 137
29	3-Chlorobiphenyl	284-5	16			202-3	4,4'			Oxid → 3-chlorobenzoic acid, 158, 155

\* Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**C) Aryl halides 2. Chlorides b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point, °C	Nitro derivative		Sulfonamide		Miscellaneous
				M P	Position of nitro groups	M P	Position of sulfonamide group	
1	2-Chlorobenzotrichloride	29	283					Hydrolysis → 2-chlorobenzoic acid, 142 Oxid → 2,4,6-trichlorobenzoic acid, 160-1
2	2,4,6-Trichlorotoluene	33 4, 38		54 50 178 80	3, 3 5			
3	2-Chlorobiphenyl	34	273					Oxid → 2-chlorobenzoic acid, 141 n <sub>D</sub> <sup>20</sup> 1.6337, D <sub>4</sub> <sup>20</sup> 1.3147 Oxid CrO <sub>3</sub> /ac a → 5,6-dichloro-1,4-naphthoquinone, 181
4	1,2-Dichloronaphthalene	35	296	169	<i>di</i>			
5	2,3,4-Trichlorotoluene	41	231 <sup>761</sup>	60, 140-1	5 or 6, 5,6			Oxid → 2,3,4-trichlorobenzoic acid, 186-7
6	1,2,3,4-Tetrachlorobenzene	44-5	254	63 5, 151	5, 5,6			
7	3,4,5-Trichlorotoluene	44-5	245 <sup>768</sup>	81 2, 163-4	2, 2,6			Oxid → 3,4,5-trichlorobenzoic acid, 203, Cl <sub>2</sub> $\xrightarrow{\text{Al/Hg}}$ → 2,3,4,5-tetrachlorotoluene, 97-8 dil HNO <sub>3</sub> → 2,3,5-trichlorobenzoic acid, 162
8	2,3,5-Trichlorotoluene	45-6	232	58 9, 149-50	4 or 6, 4,6			
9	1,6-Dichloronaphthalene	48		119	4	216	4	Sulfonyl chloride, 65
10	1,2,3,5-Tetrachlorobenzene	50-1	246	40-1, 161-2	4, 4,6			
11	1,2,3-Trichlorobenzene	52 3	218-9	56, 92-3	4, 4,6	226-30	4	Sulfonyl chloride, 65
12	1,4-Dichlorobenzene	53	173	54	2	180 186	2	
13	4,4'-Dichlorodiphenylmethane	55	337	198-9	3,3'			Oxid $\xrightarrow{\text{CrO}_3/\text{ac a}}$ → 4,4'-dichlorobenzophenone, 145 Picrate, 81
14	2-Chloronaphthalene	56, 61	265	175	1,8	126		Oxid $\xrightarrow{\text{dil HNO}_3}$ → phthalic acid, 200-6
15	2,2'-Dichlorobiphenyl	60		203-5	5,5'			
16	1,3-Dichloronaphthalene	61	291 <sup>775</sup>	150 and 158	<i>di</i>			Sulfonyl chloride, 35-40 Sulfonyl chloride, 118
17	1,3,5-Trichlorobenzene	63	208	68	2	210 2		
18	1,7-Dichloronaphthalene	63-4	286	138-9		226	4	Oxid $\xrightarrow{\text{CrO}_3/\text{ac a}}$ → 5,8-dichloro-1,4-naphthoquinone, 173 4 Boiling HNO <sub>3</sub> (D = 1.3) → 3,6-dichlorophthalic acid, 194 185
19	1-Bromo-4-chlorobenzene	67	197	72	2			
20	1,4-Dichloronaphthalene	68	286 <sup>740</sup>	92	8	244	6	Oxid → 2,5-dichloroterephthalic acid, 306
21	2,5-Dichloro-1,4-dimethylbenzene (2,5-Dichloro <i>p</i> -xylene)	68	224					Oxid → 4-chlorobenzoic acid, 240
22	4-Chlorobiphenyl	77	293					Oxid → 2,4,5-trichlorobenzoic acid, 168
23	2,4,5-Trichlorotoluene	82	230 <sup>715</sup>	89-90, 226 7	3, 3,6			Sulfonyl chloride, 141
24	Pentachlorobenzene	86, 84	276	143, 146	6	228	4	
25	1,8-Dichloronaphthalene	89						Oxid $\xrightarrow{\text{CrO}_3/\text{ac a}}$ → 3-chlorophthalic acid, 185 7 Picrate, 87
26	1,5-Dichloronaphthalene	107		142	8	204	3	dil HNO <sub>3</sub> → 4-chlorophthalic acid, 157
27	2,7-Dichloronaphthalene	114 5		141 2	<i>mono</i>	218	3	Sulfonyl chloride, 136, Cl <sub>2</sub> in chl → 1,2,6-trichloronaphthalene, 92 Oxid CrO <sub>3</sub> /ac a → 1,4-naphthoquinone deriv 148 9
28	2,6-Dichloronaphthalene	135-6	285			269	4	
29	1,2,4,5-Tetrachlorobenzene	140	245	99, 232	3, 3,6			Chlorosulfonic acid → hexachlorobenzene, 229
30	4,4'-Dichlorobiphenyl	149						Oxid → 4-chlorobenzoic acid, 240

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**C) Aryl halides 2. Chlorides b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Nitro derivative		Sulfonamide		Miscellaneous
				M P	Position of nitro groups	M P	Position of sulfonamide group	
31	<b>5,6,7,8-Tetrachlorotetralin</b>	174	180 <sup>26</sup>					Br <sub>2</sub> in CS <sub>2</sub> → 1,2-dibromo-5,6,7,8-tetrachloronaphthalene, 142
32	<b>1,2,3,4-Tetrachlorotetralin</b>	182, 187						Oxid $\xrightarrow{\text{CrO}_3/\text{ac a}}$ 2,4-dichloro-1-naphthol, 106-7 Boiling HNO <sub>3</sub> → phthalic acid, 200-6
33	<b>Octachloronaphthalene</b>	198, 200	442					Oxid $\xrightarrow{\text{fuming HNO}_3}$ hexachloro-1,4-naphthoquinone, 222 SbCl <sub>5</sub> in CCl <sub>4</sub> → cherry-red color
34	<b>9,10-Dichloroanthracene (meso-Dichloroanthracene)</b>	209-10, yel				279	2	Sulfonyl chloride, 221-5, Oxid → 9,10-anthraquinone, 286. Maleic anhydride adduct, 258-9
35	<b>Hexachlorobenzene</b>	229, subl, 226	309					Boiling with fuming HNO <sub>3</sub> + conc H <sub>2</sub> SO <sub>4</sub> → tetrachloro-1,4-benzoquinone (chloroanil), 290

\* Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**C) Aryl halides 3. Bromides a) Liquids (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Nitro derivative		Sulfonamide		Miscellaneous
						M P	Position of nitro groups	M P	Position of sulfonamide group	
1	<b>Bromobenzene</b>	156		1 560	1 494	70-2	2,4	166 161	4	1-Naphthylamide, 161, 2,4-Dinitrobenzenesulfonyl chloride adduct 140-1
2	<b>2-Bromotoluene</b>	182			1 425	82	3,5	146	5	Oxid → 2-bromobenzoic acid, 150
3	<b>3-Bromotoluene</b>	184			1 410	103	4,6	168	6	Oxid → 3-bromobenzoic acid, 155
4	<b>1-Bromo-2-ethylbenzene</b>	199		1 5486	1 355					Oxid → 2-bromobenzoic acid, 150
5	<b>1-Bromo-4-ethylbenzene</b>	205		1 5448	1 342					Oxid → 4-bromobenzoic acid, 251
6	<b>1-Bromo-2-vinylbenzene (o-Bromostyrene)</b>	210		1 5927	1 4160					Polymerizes on heating with benzoyl peroxide
7	<b>1-Bromo-2-isopropylbenzene</b>	210		1 5408	1 3020					Oxid → 2-bromobenzoic acid, 150
8	<b>1-Bromo-4-vinylbenzene (p-Bromostyrene)</b>	212		1 5947	1 398					Polymerizes on heating with benzoyl peroxide, Oxid → 4-bromobenzoic acid, 251
9	<b>1-Bromo-2,3-dimethylbenzene</b>	217								Oxid → 3-bromophthalic acid, 188
10	<b>1,3-Dibromobenzene</b>	219		1 606	1 952	61	4	190	6	
11	<b>1-Bromo-4-isopropylbenzene</b>	219		1 5361	1 2854					Oxid → 4-bromobenzoic acid, 251
12	<b>1,2-Dibromobenzene</b>	219		1 609	1 956	114	4,5	176	4	
13	<b>2-Bromocymene</b>	234			1 267	97				Anilide, 143
14	<b>2,5-Dibromotoluene</b>	236			1 811					Oxid → 2,5-dibromobenzoic acid, 157
15	<b>3,4-Dibromotoluene</b>	240			1 81					Oxid → 3,4-dibromobenzoic acid 235
16	<b>1-Bromonaphthalene</b>	281		1 658	1 484	85	4	191 3	4	Picrate, 134, Carbonation of Grignard → 1-naphthoic acid, 162
17	<b>2-Bromobiphenyl</b>	297								Oxid → 2-bromobenzoic acid, 150

\* Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**C) Aryl halides 3. Bromides b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point, °C	Nitro derivative		Sulfonamide		Miscellaneous
				M P	Position of nitro groups	M P	Position of sulfonamide group	
1	<b>4-Bromotoluene</b>	28-9	184					Oxid → 4-bromobenzoic acid, 251
2	<b>2-Bromonaphthalene</b>	59	281			208	8	Picrate, 86, 79, 2,4,7-Trinitrofluorenone adduct, 138-40
3	<b>1,2-Dibromonaphthalene</b>	67						Oxid → 3,4-dibromophthalic acid, 196
4	<b>1,4-Dibromonaphthalene</b>	82						Oxid → 3,6-dibromophthalic acid, 135
5	<b>1,4-Dibromobenzene</b>	89	219	84	2,5	195	2	
6	<b>4-Bromobiphenyl</b>	89	310					Oxid → 4-bromobenzoic acid, 251
7	<b>1,3,5-Tribromobenzene</b>	120	271			222	2	
8	<b>4,4'-Dibromobiphenyl</b>	164						Oxid → 4-bromobenzoic acid, 251
9	<b>1,2,4,5-Tetrabromobenzene</b>	180		168	3			

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**C) Aryl halides 4. Iodides a) Liquids (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Nitro derivative		Sulfonamide		Miscellaneous
						M P	Position of nitro groups	M P	Position of sulfonamide group	
1	Iodobenzene	188-7		1.620	1.831	171	4			Br <sub>2</sub> → 1-Bromo-4 iodobenzene 91 Oxid → 3-iodobenzoic acid, 187 Oxid → 2-iodobenzoic acid, 162 Cl <sub>2</sub> in chl → dichloride (ArCl <sub>2</sub> ) 110 Picrate, 128
2	3-Iodotoluene	204			1.698	108	4,6			
3	2-Iodotoluene	211			1.698	103	6			
4	1-Iodo-4-isopropylbenzene	236-8								
5	1-Iodonaphthalene	305								

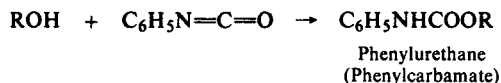
\* Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**C) Aryl halides 4. Iodides b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point, °C	Nitro derivative		Sulfonamide		Miscellaneous
				M P	Position of nitro groups	M P	Position of sulfonamide group	
1	4-Iodotoluene	35	211					HNO <sub>3</sub> at 200° → 4-iodobenzoic acid, 270 Cl <sub>2</sub> in chl → dichloride (ArICl <sub>2</sub> ), 66  Picrate, 95 Cl <sub>2</sub> in chl → dichloride (ArICl <sub>2</sub> ), 102
2	1-Iodo-2,4,5-trimethylbenzene	37	256-8					
3	1,3-Di-iodobenzene	40	285					
4	2-Iodonaphthalene	55	309					
5	4-Iodobiphenyl	114	320 d					
6	1,4-Di-iodobenzene	129	289	171	2,5			

\*Derivative data given in order m p , crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE VI

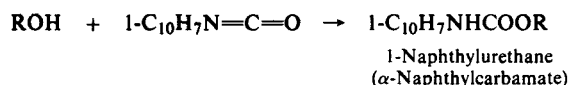
*Phenylurethane.*

From the dry alcohol with phenylisocyanate without solvent.

For directions and examples see: Linstead, pp. 34-35; Shriner, p. 211; Vogel, p. 264; B. T. Dewey and N. F. Witt, *Ind. Eng. Chem., Anal. Ed.*, **12**, 459 (1940); **14**, 648 (1942).

From the dry alcohol with phenylisocyanate in petrol ether.

See: Wild, pp. 55-57.

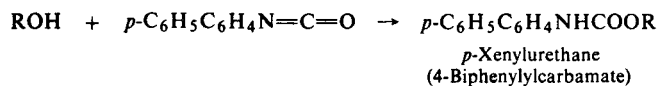
*1-Naphthylurethane ( $\alpha$ -Naphthylcarbamate).\**

From the dry alcohol with 1-naphthylisocyanate without solvent.

For directions and examples see: Cheronis, pp. 475-479; Linstead, pp. 34-35; Shriner, p. 211; Vogel, p. 264; V. T. Bickel and H. E. French, *J. Amer. Chem. Soc.*, **48**, 747 (1926); H. E. French and A. F. Wirtel, *J. Amer. Chem. Soc.*, **48**, 1736 (1926).

From the dry alcohol with 1-naphthylisocyanate in petrol ether.

See: Cheronis, pp. 476-477; Wild, pp. 55-57.

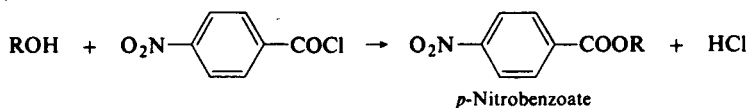
*p-Xenylurethane (4-Biphenylurethane).*

From the alcohol with *p*-xenylisocyanate in toluene.

For directions and examples see: G. T. Morgan and A. E. J. Pettet, *J. Chem. Soc.*, 1124 (1931); B. Witten and E. E. Reid, *J. Amer. Chem. Soc.*, **69**, 2470 (1947).

From the alcohol with *p*-xenylisocyanate in a benzene-petrol ether mixture.

See: M. J. van Gelderen, *Rec. Trav. chim.*, **52**, 969 (1933).

*p-Nitrobenzoate.\**

From the alcohol in excess and *p*-nitrobenzoyl chloride.

For directions and examples see: Cheronis, pp. 467-469, 471; Shriner, p. 212; Vogel, p. 263; Wild, p. 52; M. D. Armstrong and J. E. Copenhaver, *J. Amer. Chem. Soc.*, **65**, 2252 (1943).

From an aqueous solution of the alcohol with *p*-nitrobenzoyl chloride in a ligroin-benzene mixture.

See: Cheronis, pp. 468-469, 472.

From the alcohol with *p*-nitrobenzoyl chloride in pyridine.

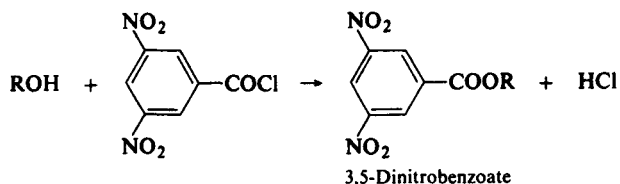
See: Shriner, p. 212; Wild, p. 52; L. F. King, *J. Amer. Chem. Soc.*, **61**, 2383 (1939).

From the alcohol with *p*-nitrobenzoyl chloride in aqueous sodium hydroxide.

See: Wild, p. 52.

From the alcohol with *p*-nitrobenzoyl chloride in an aqueous solution of sodium acetate and potassium hydroxide at low temperature.

See: Wild, p. 53; F. A. Menalda, *Rec. Trav. chim.*, **49**, 967 (1930); H. Henstock, *J. Chem. Soc.*, 216 (1933).

*3,5-Dinitrobenzoate.\**

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.



## EXPLANATIONS AND REFERENCES TO TABLE VI (Continued)

From the alcohol in excess with 3,5-dinitrobenzoyl chloride.

For directions and examples see: Cheronis, pp. 467-470; Shriner, pp. 212-213; Vogel, p. 262; G. B. Malone and E. E. Reid, *J. Amer. Chem. Soc.*, **51**, 3424 (1929).

From an aqueous solution of the alcohol with 3,5-dinitrobenzoyl chloride in a ligroin-benzene mixture.

See: Cheronis, pp. 468-469, 472.

From the alcohol with 3,5-dinitrobenzoyl chloride and pyridine in benzene.

See: Linstead, p. 34; Wild, p. 53; T. Reichstein, *Helv. chim. Acta*, **9**, 799 (1926); W. M. D. Bryant, *J. Amer. Chem. Soc.*, **54**, 3758 (1932).

From the alcohol with 3,5-dinitrobenzoyl chloride and a catalytic amount of pyridine in isopropyl or *n*-butyl ether.

See: Cheronis, pp. 469, 471.

From the alcohol with 3,5-dinitrobenzoyl chloride in pyridine.

See: Cheronis, p. 469; Shriner, pp. 212-213; Vogel, pp. 262-263.

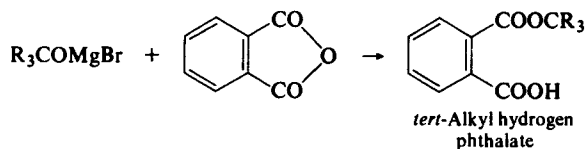
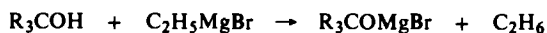
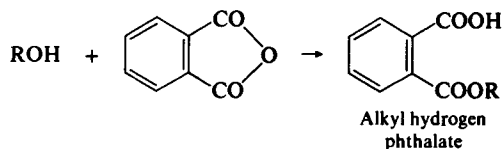
From the alcohol with 3,5-dinitrobenzoyl chloride in aqueous potassium hydroxide.

See: Linstead, p. 34.

From the alcohol in aqueous sodium hydroxide and potassium acetate with 3,5-dinitrobenzoyl chloride in a benzene-ligroin mixture.

See: Wild, pp. 53-54; W. N. Lipscomb and R. H. Baker, *J. Amer. Chem. Soc.*, **64**, 179 (1942).

### Hydrogen phthalate.\*



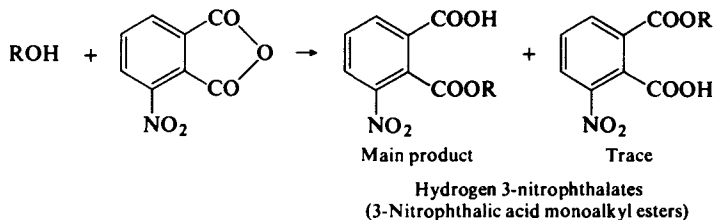
From the alcohol with phthalic anhydride.

For directions and examples see: E. E. Reid, *J. Amer. Chem. Soc.*, **39**, 1250 (1917); J. F. Goggans and J. E. Copenhaver, *J. Amer. Chem. Soc.*, **61**, 2909 (1939).

From the alkoxy magnesium halide derived from a tertiary alcohol (prepared from the alcohol with ethylmagnesium bromide) with phthalic anhydride in ether or an ether-dioxan mixture.

See: W. A. Fessler and R. L. Shriner, *J. Amer. Chem. Soc.*, **58**, 1384 (1936).

### Hydrogen 3-nitrophthalate.\*



From the alcohol with 3-nitrophthalic anhydride.

For directions and examples see: Cheronis, pp. 473-474; Linstead, p. 35; Shriner, p. 213; Vogel, p. 265; Wild, p. 59; G. M. Dickinson, L. H. Crosson and J. E. Copenhaver, *J. Amer. Chem. Soc.*, **59**, 1094 (1937); B. H. Nicolet and J. Sacks, *J. Amer. Chem. Soc.*, **47**, 2348 (1925); A. J. Veraguth and H. Diehl, *J. Amer. Chem. Soc.*, **62**, 233 (1940).

From a high boiling alcohol with 3-nitrophthalic anhydride in toluene.

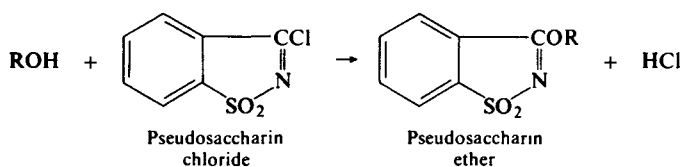
See: Linstead, p. 35; Shriner, p. 213; Vogel, p. 265; Wild, p. 59; G. M. Dickinson, L. H. Crosson and J. E. Copenhaver, *J. Amer. Chem. Soc.*, **59**, 1094 (1937).

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

## EXPLANATIONS AND REFERENCES TO TABLE VI (Continued)

*Pseudosaccharin ether (Pseudosaccharin derivative).*



From the alcohol with pseudosaccharin chloride without solvent.

*For directions and examples see:* Vogel, p. 266; Wild, pp. 60-61; J. R. Meadoc and E. E. Reid, *J. Amer. Chem. Soc.*, **65**, 457 (1943).

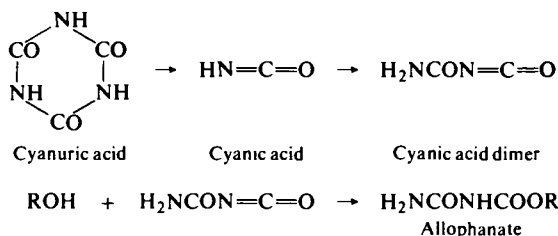
From the alcohol with pseudosaccharin chloride in chloroform.

*See:* H. Böhme and H. Opper, *Z. Anal. Chem.*, **139**, 255 (1953).

From the alcohol with pseudosaccharin chloride and a catalytic amount of pyridine in chloroform.

*See:* Cheronis, p. 482; H. Böhme and H. Opper, *Z. Anal. Chem.*, **139**, 255 (1953).

*Allophanate*



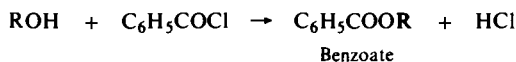
From the alcohol with cyanic acid (prepared from the depolymerization of cyanuric acid).

*For directions and examples see:* Linstead, p. 36; A. Behál, *Compt. rend.*, **168**, 945 (1919); M. A. Spielman, J. D. Barnes and W. J. Close, *J. Amer. Chem. Soc.*, **72**, 2520 (1950); H. W. Blohm and E. I. Becker, *J. Amer. Chem. Soc.*, **72**, 5342 (1950); *Chem. Revs.*, **51**, 471 (1952).

From the alcohol with sodium cyanate and dry hydrochloric acid in dioxane.

*See:* E. S. Lane, *J. Chem. Soc.*, 2764 (1951).

*Benzoate.\**



*Especially for polyhydric alcohols.*

From the alcohol with benzoyl chloride.

*For directions and examples see:* Shriner, p. 212.

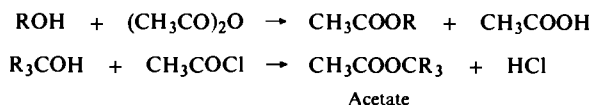
From the alcohol with benzoyl chloride in anhydrous pyridine.

*See:* Cheronis, pp. 481-482; Shriner, p. 212; Vogel, pp. 243, 447.

From the alcohol with benzoyl chloride in aqueous sodium hydroxide.

*See:* Vogel, p. 447.

*Acetate.*



*Especially for polyhydric alcohols.*

From the alcohol with acetic anhydride and sodium acetate.

*For directions and examples see:* Linstead, pp. 35, 39; Shriner, p. 212.

From the alcohol with acetic anhydride in pyridine.

*See:* Shriner, p. 212.

From the alcohol (especially a tertiary alcohol) with acetyl chloride in the presence of magnesium.

*See:* A. Spassow, *Chem. Ber.*, **70B**, 1926 (1937).

**NOTE:** For additional information regarding directions and examples for the preparation of derivatives of polyhydric alcohols see explanations and references to Table XIX, p. 326.

**\*Derivatives recommended for first trial.**

**WARNING:** This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS

a) Liquids (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Phenyl-urethane	1 Naphthyl-urethane	4 Nitro-benzoate	3,5-Dinitro-benzoate	Hydrogen 3-nitro-phthalate	Hydrogen phthalate	Miscellaneous
1	<b>Methanol</b> (Methyl alcohol)	64.65	f.p. -97	1.3306 <sup>15</sup>	0.7915	47, al	124, lgr	96, dil al	108 (cor), al	153 (cor)	82.5 (cor)	Pseudosaccharin ether, 182 (cor)
2	<b>Ethanol</b> (Ethyl alcohol)	78.32	f.p. -117.3	1.3610	0.7894	52	79, lgr	57, al	93, al	158 (cor), w	48	Pseudosaccharin ether, 219 (cor)
3	<b>2-Propanol</b> (Isopropyl alcohol)	82.4	-89.5	1.37927	0.78507	75-6, lt pet	106	110.5, lt pet	108	123, pet eth	154 (cor), w	Pseudosaccharin ether, 137 (cor)
4	<i>d,l</i> -3-Buten-2-ol (Methyl vinyl carbinol)	94-6									43-4	Allophanate, 152, Constant boil mixt with 21.76% w, b.p. 80
5	<b>2-Propen-1-ol</b> (Allyl alcohol)	97.1		1.41345	0.8540	70	108	28	49-50	124		
6	<b>1-Propanol</b> ( <i>n</i> -Propyl alcohol)	97.1		1.38499	0.80359	57, pet	80, 76	35, pet	74, pet eth	145.5 (cor), w	54.1-4 (cor), pet eth-bz (9.1)	Pseudosaccharin ether, 124.5 (cor)
7	<b>2-Butanol</b> ( <i>d,l</i> - <i>sec</i> -Butyl alcohol, Ethyl methyl carbinol)	99.5		1.39495 <sup>25</sup>	0.80692	64.5, pet	97	25-6, dil al	76	131 (cor)	59-60	Pseudosaccharin ether, 65.5 (cor)
8	<b>2-Methyl-2-butanol</b> ( <i>tert</i> -Amyl alcohol)	102.3	-8.55	1.4052	0.80889	42, pet eth	72	85	116, 117-8			
9	<b>2-Fluoroethanol</b>	105		1.3633 <sup>25</sup>			128					
10	<b>2-Methyl-1-propanol</b> (Isobutyl alcohol)	108.1		1.3939 <sup>25</sup>	0.80196	86, lgr	104	69	87	180.5 (cor)	65, pet eth	Pseudosaccharin ether, 100 (cor)
11	<b>3-Buten-1-ol</b>	122.5-3.5 <sup>25</sup>				23.4-4.5						
12	<i>d,l</i> -3-Methyl-2-butanol ( <i>sec</i> -Isoamyl alcohol, <i>d,l</i> -Isopropyl methyl carbinol)	114, <i>d</i> 110-2		1.3973	0.8180	68	109			127	39, <i>d</i> 34, <i>l</i> 34	<i>d</i> [ $\alpha$ ] <sub>D</sub> <sup>20</sup> + 5.34, in al
13	<b>3-Pentanol</b> ( <i>sym-sec</i> -Amyl alcohol, Diethyl carbinol)	116.1		1.4103	0.82037	48-9	95, lgr	17	101, 99, 97	121		
14	<b>1-Butanol</b> ( <i>n</i> -Butyl alcohol)	117.6, 116	-90.2	1.3974 <sup>25</sup>	0.80960	61	71	70, 64 35-6	64, 62.5	147 (cor)	73.1-5 (cor)	Pseudosaccharin ether, 96 (cor)
15	<i>d,l</i> -2-Pentanol ( <i>sec</i> -Amyl alcohol)	119.85		1.4060	0.80919		74.5, 76, <i>d</i> 88-91	17	62	102-3	60-1, <i>d</i> 34, <i>l</i> 34	Pseudosaccharin ether, 38 (cor)
16	<b>3,3-Dimethyl-2-butanol</b> ( <i>d,l</i> -Pinacolyl alcohol, <i>tert</i> -Butyl methyl carbinol)	120.4	5.3	1.4148	0.8185	77-8, pet eth			107, yel-wh, pet eth		85-6, lt pet	
17	<b>2,3-Dimethyl-2-butanol</b> (Dimethyl isopropyl carbinol)	120.5	-14	1.4140	0.8208	65-6, pet eth	101		111, yel, bz-pet eth			
18	<b>3-Methyl-3-pentanol</b>	123	-22	1.4166 <sup>25</sup>	0.82334 <sup>25</sup>	43.5	83.5		96.5, yel, pet eth, 62.5			Allophanate, 152 (cor)

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS

a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	Phenyl urethane	1-Naphthyl urethane	4 Nitrobenzoate	3,5-Dinitrobenzoate	Hydrogen 3-nitrophthalate	Hydrogen phthalate	Miscellaneous
19	<b>2-Methyl-2-pentanol</b> (Dimethyl <i>n</i> -propyl carbinol)	123, 121	-103, -108	1.4113	0.81341				72			Benzoate, 182.3, al, Allophanate, 128
20	<b>2-Methoxyethanol</b> (Methyl cellosolve, Ethylene glycol monomethyl ether)	124.5		1.40238	0.9647		112.5, 3.0	50.5, dil al		129, dil al		Diphenyl urethane, 51
21	<b>2-Methyl-3-pentanol</b> (Ethyl isopropyl carbinol)	127.5		1.4168	0.82487	50				150.7	70.69, 71, racemic	
22	<b>1-Chloro-2-propanol</b>	127								77		
23	<b>2-Methyl-1-butanol</b> (Active amyl alcohol, <i>d</i> -sec-Butyl carbinol)	128.9		1.4107	0.8193	31	82, lgr			70	157.8, w	$[\alpha]_D^{20} -5.756$
24	<b>2-Chloroethanol</b> (Ethylene chlorohydrin)	131				51	101				98	
25	<b><i>d,l</i>-4-Methyl-2-pentanol</b> (Isobutyl methyl carbinol)	132		1.4011	0.80713	143, et ac	88	26		65, yel, pet eth		
26	<b>3-Methyl-1-butanol</b> ( <i>prim</i> -Isoamyl alcohol)	132	-117	1.40851 <sup>15</sup>	0.80918	56-7, lgr	68	21		61	166.3 (cor), 30% al, 165-6, w	Pseudosaccharin ether, 64 (cor)
27	<b><i>d,l</i>-2-Chloro-1-propanol</b>	133.4		1.436	1.103					76		Alkali + heat → propylene oxide b p 35
28	<b>3-Methyl-2-pentanol</b> ( <i>sec</i> -Butyl methyl carbinol)	134.2 <sup>749</sup>					72			43.5, yel, pet eth, 41		
29	<b>2-Ethoxyethanol</b> (Ethylene glycol monoethyl ether)	135		1.40797	0.9297		67.3-5			75, al	118.8.6 (anh), 94.2.4 (monohyd) x-al	Diphenyl urethane, 43
30	<b>3-Hexanol</b> (Ethyl <i>n</i> -propyl carbinol)	136		1.4159	0.81851					97, yel-wh, pet eth	76-7, pet eth	
31	<b>2,2-Dimethyl-1-butanol</b> ( <i>tert</i> -Amyl carbinol)	136.7		1.4208	0.82834	65-6	80-1, lgr				51, yel, pet eth	Pseudosaccharin ether, 68-9 lit pet
32	<b>1-Pentanol</b> ( <i>n</i> -Amyl alcohol)	138 (cor)	-78.5	1.40994	0.81479	46	68	11		46.4	136 (cor)	Pseudosaccharin ether, 62 (cor)
33	<b><i>d,l</i>-2-Hexanol</b> ( <i>n</i> -Butyl methyl carbinol)	138.9 <sup>745</sup>		1.4126 <sup>25</sup>	0.80977 <sup>25</sup>		60.5	40		38.5		3,5-Dinitrophenyl urethane, 40
34	<b>2,4-Dimethyl-3-pentanol</b>	140		1.42259	0.8288	95, eth-pet eth, 96-9	95, 99	155			150-1	Camphor-like odor
35	<b>Cyclopentanol</b>	140.85		1.4530	0.94688	132.5, al	118					
36	<b>2-Isopropoxyethanol</b> (Ethylene glycol monoisopropyl ether)	141.5 <sup>736</sup>		1.40954	0.9030							Triphenylmethyl ether, 71.0-5, me al

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS.**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Phenyl-urethane	1 Naphthyl-urethane	4 Nitrobenzoate	3,5-Dinitrobenzoate	Hydrogen 3-nitrophthalate	Hydrogen phthalate	Miscellaneous
37	<b>3-Ethyl-3-pentanol</b> (Triethyl carbinol)	142		1.4305	0.83889							Camphor-like odor, Allophanate, 152 (cor)
38	<b>2,3-Dimethyl-1-butanol</b>	145		1.4195	0.8297 <sup>20.5</sup>	28.9			51.5, pale, pet eth			
39	<b>3-Hydroxy-2-butanone</b> ( <i>d,l</i> -Acetoin, Acetyl methyl carbinol)	145	-72	1.4178	0.9861 <sup>30</sup>							Semicarbazone, 185, al, 202, 2,4-Dinitrophenylhydrazones, 318, or, PhNO <sub>2</sub> -tol
40	<b>1-Hydroxy-2-propanone</b> (Acetol Acetyl carbinol)	146	-17	1.4295	1.0824 <sup>20</sup>							Semicarbazone, 196, al, 2,4-Dinitrophenylhydrazones, 128.5 (cor), or, al
41	<b>2-Methyl-1-pentanol</b> (2-Methyl- <i>n</i> -amyl alcohol)	148.0		1.4190	0.8208		75.6		50.5, yellow, pet eth	145, 141, bz		
42	<b>2-Ethylbutanol</b>	148.9		1.4224	0.83345				51.5, pet eth			
43	<b>2-Bromoethanol</b> (Ethylene bromohydrin)	149d					86					
44	<b>2-<i>n</i>-Propoxyethanol</b> (Ethylene glycol mono- <i>n</i> -propyl ether)	150.0 <sup>736</sup>		1.41328	0.9112							
45	<b>Trichloroethanol</b>	151	19			87	120	71, al	142.3			Urethane 64.5
46	<b>3-Methyl-1-pentanol</b>	151-2 153.7 4.1		1.4188	0.8242		58 <i>d,l</i> 40-1, <i>d</i> 38-40 137.8		38, yellow, pet eth			
47	<b>4-Methyl-1-pentanol</b> (Isoamyl carbinol, Isohexyl alcohol)	152.3		1.4153	0.8131	48 (cor)			72, pet eth 69.8 (cor)	138.5 40, bz pet eth		
48	<i>d,l</i> - <b>4-Heptanol</b> (Di- <i>n</i> -propyl carbinol)	156	-41.5	1.4205	0.8183		78.80	35	64		60	
49	<b>1-Hexanol</b> ( <i>n</i> -Hexyl alcohol)	157.5	-51.6 -46.1	1.41778	0.81893	42	59.62	5	58.4 (cor), 60.1	124 (cor), 123	25	Pseudosaccharin ether 60 (cor)
50	<i>d,l</i> - <b>2-Heptanol</b> ( <i>n</i> -Amyl methyl carbinol, <i>sec</i> -Heptyl alcohol)	158.7		1.4210	0.8167		54		49.4		57.5 <i>d,l</i> 76.5	
51	<b>2-Isobutoxyethanol</b> (Ethylene glycol mono-isobutyl ether)	159.3 <sup>746</sup>		1.41428	0.8900							
52	<b>2-<i>sec</i>-Butoxyethanol</b> (Ethylene glycol mono- <i>sec</i> -butyl ether)	159.3 <sup>746</sup>		1.41606	0.8966							
53	<b>2,4-Dimethyl-1-pentanol</b>	159.8		1.427	0.793					154-5, bz-pet eth		<i>p</i> -Xenylurethane, 74-5, pet

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Phenylurethane	1-Naphthylurethane	4-Nitrobenzoate	3,5 Dinitrobenzoate	Hydrogen 3-nitrophthalate	Hydrogen phthalate	Miscellaneous
54	<b>3-Chloro-1-propanol</b> (3-Chloropropyl alcohol)	161.2				38	76		77			
55	<b>2-Methyl-1-hexanol</b>	164.5		1.4250	0.8270					131.2, wh, pet		<i>p</i> -Xenylurethane, 88.0-5, pet
56	<b>2-Ethyl-1-pentanol</b> (2-Ethyl- <i>n</i> -amyl alcohol)	164.6								127.8, bz-pet		<i>p</i> -Xenylurethane, 77-77.5, pet
57	<i>d,l</i> - <b>4-Methyl-1-hexanol</b>	165.173		1.4219	0.8239		50			149		Odor of Amyl alcohol
58	<i>d,l-cis</i> - <b>2-Methylcyclohexanol</b> ( <i>cis</i> -Hexahydro- <i>o</i> -cresol)	165.3	-9.3	1.4640	0.9340	90.1, 93.4		51.2, 55.6	98.9		103.4, 104.5	
59	<b>4-Hydroxy-4-methyl-2-pentanone</b> (Diacetone alcohol)	166			0.9306 <sup>25</sup>			48	55			Oxime, 57.5-8.5 lgr-eth
60	<i>d,l-trans</i> - <b>2-Methylcyclohexanol</b> ( <i>trans</i> -Hexahydro- <i>o</i> -cresol)	167.4	21	1.4611	0.9235	105, mixt <i>cis</i> + <i>trans</i> <sup>7</sup>		65, mixt <i>cis</i> + <i>trans</i> <sup>35-6</sup>	114.5, mixt <i>cis</i> + <i>trans</i> <sup>85-90</sup>		124.5, mixt <i>cis</i> + <i>trans</i> <sup>95-6</sup>	
61	<b>2-<i>n</i>-Butoxyethanol</b> (Ethylene glycol mono- <i>n</i> -butyl ether)	170-6 <sup>743</sup>		1.4177 <sup>26</sup>	0.9188	62				120.0, 6		4-Nitrophenylurethane, 58.7-9.1, CCl <sub>4</sub> , N-1-Naphthylurea, 186 (cor) Picrate, 160
62	<b>2-Aminoethyl alcohol</b> (Ethanolamine)	171										<i>p</i> -Xenylurethane, 118 Allophanate, 156
63	<b>2,6-Dimethyl-4-heptanol</b> (Di-isobutyl carbinol)	171.4, 3.4		1.4242	0.8129 <sup>20</sup>	61.2, lgr-al					118	
64	<b>Furfuryl alcohol</b> (2-Furyl carbinol)	172.170		1.4863	1.1351 <sup>20</sup>	45	129.30, lgr, 133	76	80.1		85	Urethane, 50, Pseudosaccharin ether 55
65	<i>d,l-cis</i> - <b>3-Methylcyclohexanol</b> ( <i>cis</i> -Hexahydro- <i>m</i> -cresol)	173.4		1.4572	0.919	87.8	128.9	65	91.2		82-3	
66	<i>d,l-cis</i> - <b>4-Methylcyclohexanol</b> ( <i>cis</i> -Hexahydro- <i>p</i> -cresol)	173.4 <sup>750</sup>		1.4549	0.914	118.9		94	134		72.3	
67	<i>d,l-trans</i> - <b>4-Methylcyclohexanol</b> ( <i>trans</i> -Hexahydro- <i>p</i> -cresol)	173.4 <sup>574</sup>		1.4534	0.913	124.5, mixt <i>cis</i> + <i>trans</i> <sup>112-5</sup>		67	139.40, mixt <i>cis</i> + <i>trans</i> <sup>125-30</sup>		119-25, ac a	
68	<i>d,l-trans</i> - <b>3-Methylcyclohexanol</b> ( <i>trans</i> -Hexahydro- <i>m</i> -cresol)	174.5		1.4550	0.9145	93.4, mixt <i>cis</i> + <i>trans</i> <sup>75-85</sup>	122	58	97.8, mixt <i>cis</i> + <i>trans</i> <sup>80-5</sup>		93.4	
69	<b>2,6-Dimethylcyclohexanol</b>	174-5 <sup>748</sup>		1.4619	0.9115, 0.9235	158						
70	<i>cis</i> - <b>2,5-Dimethylcyclohexanol</b>	175		1.4522 <sup>14</sup>	0.9096 <sup>1</sup>							Allophanate, 157.8
71	<i>trans</i> - <b>2,4-Dimethylcyclohexanol</b>	175		1.4560	0.900	96						Acetate, b p 198 <sup>71</sup>
72	<b>1,3-Dichloro-2-propanol</b>	176				73	115					

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	Phenyl urethane	1 Naphthyl urethane	4 Nitro benzoate	3,5 Dinitro benzoate	Hydrogen 3 nitro phthalate	Hydrogen phthalate	Miscellaneous
73	3-Bromo-1-propanol (Triethylene bromohydrin)	176d					73					
74	cis-2,4-Dimethylcyclohexanol	176		1 4582	0 907							
75	1-Heptanol ( <i>n</i> -Heptyl alcohol)	176 8	-34 6 -33 8	1 4245	0 82242	60 65	62	10	46 47	127 (cor)	16 5-17 5	Pseudosaccharin ether, 55 (cor) Allophanate, 125
76	trans-2,5-Dimethylcyclohexanol	177		1 4545 <sup>17</sup>	0 9079 <sup>17</sup>							
77	2,2-Dimethylcyclohexanol	177	8	1 4648	0 9225	85						
78	Tetrahydrofurfuryl alcohol	177-8 <sup>43</sup>		1 45167	1 0544	61, pet eth bis		46-8	83-4			Diphenylurethane, 81, me al
79	2-Methyl-1,2-propanediol (Isobutylene glycol)	178		1 4358 <sup>17</sup>	0 999 <sup>14</sup>	140 5						
80	<i>d,l</i> -2-Octanol	179		1 4265	0 8205	oil	63-4, 62 5	28	32		55, <i>d,l</i> 75	
81	2,2-Dibromoethanol	179-81										Urethane 90-1
82	1,3,5-Trimethylcyclohexanol	181		1 454 <sup>10 3</sup>	0 8876 <sup>10 8</sup>							
83	2,3-Butanediol (2,3-Butylene glycol)	<i>meso</i> 181 7 <sup>42</sup> , <i>d,l</i> 176 7 <sup>42</sup>	<i>meso</i> 34 4, <i>d,l</i> 7 6	<i>meso</i> 1 43637	<i>meso</i> 1 0433	<i>meso</i> bis 201						Dibenzoate <i>d,l</i> 53 4, <i>meso</i> 75 5-6 2
84	Cyclohexyl carbinol (Hexahydrobenzyl alcohol)	182		1 4649	0 9280							Acetate, b p 199-201 <sup>740</sup>
85	2,3-Dichloropropanol	182				73	93	37-8				2-Naphthylurethane, 99
86	4-Methyl-1-heptanol	182 7								133		Pseudosaccharin ether, 34 (cor)
87	2-Ethyl-1-hexanol	184 6		1 4328	0 8328	33-4	60 1			108		<i>p</i> -Xenylurethane, 80, pet, Pseudosaccharin ether, 53 5 (cor)
88	3,3-Dimethylcyclohexanol	185 <sup>754</sup>	11 2	1 4606 <sup>15</sup>	0 9128 <sup>14</sup>			83				Acetate, b p 194-5 <sup>750</sup> , <i>o</i> -Nitrobenzoate, 62
89	cis-3,5-Dimethylcyclohexanol	187		1 454 <sup>21</sup>	0 9109 <sup>21</sup>							Acetate, b p 201-2
90	trans-3,5-Dimethylcyclohexanol	<i>d,l</i> 187		1 4579	<i>d</i> 0 9146, <i>l</i> 0 9166							Acetate, <i>d,l</i> , b p, 196 <i>d</i> , $[\alpha]_D^{25} +4 55$ , <i>l</i> , $[\alpha]_D^{25} -7 74$
91	<i>d,l</i> -1,2-Propanediol ( $\alpha$ -Propylene glycol)	187 4		1 43162 <sup>25</sup>	1 0354 <sup>23</sup>	<i>bis</i> 153, 143-4						Monostearate, 59 5, Distearate, 72 3
92	3,4-Dimethylcyclohexanol	189		1 458 <sup>16</sup>	0 9073 <sup>16</sup>	119						
93	2,4,5-Trimethylcyclohexanol	<i>cis</i> 191-3, <i>trans</i> 196				<i>cis</i> 83 5, <i>al</i> , <i>trans</i> 95, <i>al</i>					81-3 5, eth - lgr	
94	1,3,3-Trimethylcyclohexen-6-ol	193 (cor)			0 9310 <sup>13</sup>							Acetate, b p 206 7
95	2,3,6-Trimethylcyclohexanol	193-5 <sup>747</sup>			0 9119 <sup>17</sup>							

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Phenylurethane	1 Naphthylurethane	4 Nitrobenzoate	3,5-Dinitrobenzoate	Hydrogen 3-nitrophthalate	Hydrogen phthalate	Miscellaneous
96	<b>2-(2-Methoxyethoxy)-ethanol</b> (Diethylene glycol monomethyl ether)	194		1.4244	1.035 <sub>20</sub> <sup>20</sup>			92		91.4, 2.2 (anh.), 87.90 (monohyd) w-al		4-Nitrophenylurethane, 73.5, 76
97	<b>5-Nonanol</b>	194.7 <sup>13</sup>		1.4289 <sup>18</sup>							45	Allophanate, 158
98	<b>1-Octanol</b> ( <i>n</i> -Octyl alcohol)	195	-16, -16.7	1.4274 <sup>25</sup>	0.8249	74.72	67	12	61.2	128 (cor)	22	Pseudosaccharin ether 46 (cor)
99	<b>2-Methyl-2,4-pentanediol</b>	196-198		1.42976 <sup>16,7</sup>	0.9240 <sub>4</sub> <sup>17</sup>							Odor of pinacol, Heating with 2% HBr → diene, b.p. 75.5-76.0
100	<b>2-(2-Ethoxyethoxy)-ethanol</b> (Diethylene glycol monoethyl ether)	196.7 <sup>63</sup>		1.4298	1.023 <sub>20</sub> <sup>20</sup>			oil	oil	oil		4-Nitrophenylurethane, 65.8, 63
101	<b>Glycol</b> (1,2-Ethanediol)	197.85	-12.6	1.43192	1.11361	<i>di</i> 157	<i>di</i> 176	140, 141	<i>di</i> 169			<i>bis</i> -4-Nitrophenylurethane, 135.5
102	<i>d,l</i> -2-Nonanol	198.2		1.4290 <sup>25</sup>	0.81910 <sub>4</sub> <sup>25</sup>		55.5, lt pet		42.8 (cor)		42.4, <i>d,l</i> 58-9	
103	<i>l</i> -Linalool ( <i>l</i> -Linalyl alcohol)	199		1.46238	0.8622	65.6	53	70				[ $\alpha$ ] <sub>D</sub> -3 to -17
104	<b>Benzyl alcohol</b>	205.5	-15.3	1.53955	1.04540	77, 75.5, 76, pet eth	134	85	113	176	106, 104	Pseudosaccharin ether, 130 (cor)
105	<i>d,l</i> -1,3-Butanediol ( <i>d,l</i> -1,3-Butylene glycol)	207.5, 204		1.44252 <sup>19,5</sup>	1.0053	122-3, <i>d</i> 115-6	184					Diphenylurethane / 127.8
106	<i>d,l</i> -2-Decanol (Methyl <i>n</i> -octyl carbinol)	211		<i>d</i> 1.4344	<i>d</i> 0.8250		69, lt pet				48.9, <i>d</i> 38.9	
107	<b>1-Nonanol</b> ( <i>n</i> -Nonyl alcohol)	213.5		1.43105	0.8271	60, 69, 62-4	65.5	60, 66	52.2	125 (cor)	42.5	Pseudosaccharin ether, 49 (cor)
108	<b>1,3-Propanediol</b> (Trimethylene glycol)	214.7, 210-2	-30	1.43983	1.0538	<i>di</i> 137	<i>di</i> 164	<i>di</i> 119	<i>di</i> 178			Dibenzoate, 57, 59
109	<b>3-Methylbenzyl alcohol</b> (3-Tolyl carbinol)	217			0.9157 <sup>17</sup>		116					
110	$\alpha$ -4-Dimethylbenzyl alcohol ( $\alpha$ -Methyl-4-tolyl carbinol)	219			0.9668 <sub>4</sub> <sup>19,5</sup>	96, pet eth						
111	<b>1-Phenyl-<i>n</i>-propyl alcohol</b> ( <i>d,l</i> -Phenylethyl carbinol)	219		1.5257	1.0056 <sub>20</sub> <sup>20</sup>		102	59-60, 56.5, 7.8				
112	<b>2,3-Dibromo-1-propanol</b>	219d				84		59-60				3,5-Dinitrophenylurethane, 71
113	<b>2-Phenethyl alcohol</b> (2-Phenylethanol)	219.8	-25.8	1.5240	1.0235 <sub>25</sub> <sup>25</sup>	78, 79-80, al	119	61.5-2 (cor), 62-3, al	108	123	188-9	
114	<i>d,l</i> - $\alpha$ -Terpineol	221	35, <i>d,l</i> 37-8	1.4834	0.9337	112.3, me al, <i>d,l</i> 110	152, 147	139, me al	78-9, lgr		117-8, ac a	Commercial liquid, lilac-like odor

\*Derivative data given in order m p, crystal color, solvent from which crystallized



TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS  
a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	Phenyl urethane	1 Naphthyl urethane	4 Nitro benzoate	3,5 Dinitro benzoate	Hydrogen 3 nitro phthalate	Hydrogen phthalate	Miscellaneous
115	Citronellol	222 118 <sup>17</sup>										Oxid → Adipic acid, 89, Rose-like odor
116	$\alpha$ -Isopropylbenzyl alcohol ( <i>d,l</i> -Isopropyl phenyl carbinol)	222.4		1.51932 <sup>18</sup>	0.9790 <sup>20</sup>		116.7					Oxid → Isopropylphenyl ketone, b p 222
117	<i>d,l</i> -2-Undecanol ( <i>d,l</i> -2-Hendecanol Methyl <i>n</i> -nonyl carbinol)	228-9			0.8263 <sup>18</sup>						49.50	
118	2-(2- <i>n</i> -Butoxyethoxy)-ethanol (Diethylene glycol mono- <i>n</i> -butyl ether)	228-30		1.4341	0.957 <sup>20</sup>							4-Nitrophenyl-urethane 54.5-5.3
119	1,4-Butanediol (Tetra-methylene glycol)	230, 235	19.0, 5	1.4467	1.0171	<i>di</i> 183 3.5 chl 180	<i>di</i> 199, xyl	<i>di</i> 175 ac a				Dibenzoate, 81.2, eth
120	Geraniol	230		1.4766	0.8894		47.8	35	62.3	117	47, lgr	
121	1-Decanol ( <i>n</i> -Decyl alcohol)	231	5.99, 6.4	1.43682	0.8292	59.6, bz, then al	73	30.2, al	57.7	122.8 (cor)	38 (cor)	Pseudosaccharin ether, 47.5 (cor)
122	2-Phenoxyethanol (Ethylene glycol monophenyl ether)	237, 245		1.534	1.102 <sup>22</sup>					112.3		Benzoate 64 4-Toluene-sulfonate 80, al
123	3-Phenylpropanol (Hydrocinnamyl alcohol)	237.4, 235		1.53565	1.0079	45 47-8, al		45.6, 47	92	117		4 Nitrophenyl urethane 104 pet eth
124	1,5-Pentanediol (Penta-methylene glycol)	238-9		1.4499	0.9939 <sup>20</sup>	<i>di</i> 174-5 (cor) abs al	<i>di</i> 147	<i>di</i> 104-5, bz-al				
125	1-Undecanol (1-Hendecanol <i>n</i> -Undecyl alcohol)	243	15.85, 14.3			62, al, 52		99.5, al	55	123.3 (cor)	43.8, 4.1	Allophanate 156 Pseudosaccharin ether 58.5 (cor)
126	Diethylene glycol ( $\beta,\beta'$ -Dihydroxydiethyl ether)	244.5	f p -10.45	1.4475	1.1212 <sup>15</sup>		149	151 (cor), 149, ac a				
127	2-Methoxybenzyl alcohol (Saligenin-2-methyl ether)	247		1.549 <sup>17</sup>	1.0495 <sup>15</sup>		135-6					Allophanate, 180, Benzoate, 59, lgr
128	2-Benzyloxyethanol (Ethylene glycol monobenzyl ether)	265.0		1.5225	1.0700 <sup>20</sup>							Triphenylmethyl ether, 76.7, eth
129	<i>n</i> -Hexyl phenyl carbinol	275		1.501	0.946	75						
130	Triethylene glycol (Ethylene glycol di-( $\beta$ -hydroxyethyl) ether)	285, 165 <sup>14</sup>	-9.4	1.4578 <sup>15</sup>	1.1274 <sup>15</sup>							<i>bis</i> -Triphenylmethyl ether, 142.2.5, acet
131	Glycerol (1,2,3-Trihydroxypropane)	290d	17.9	1.4729	1.26134	<i>tri</i> 180	<i>tri</i> 191- 2, al	<i>tri</i> 188				4-Nitrophenyl urethane, 216 Tribenzoate, 71.2, 75.6
132	3,4-Dimethoxybenzyl alcohol (Veratryl alcohol)	296-7 <sup>20</sup>		1.555 <sup>17</sup>	1.179 <sup>17</sup>	118						Acetate, b p 170 <sup>12</sup> , $n_D^{17}$ 1.5245, Benzoate, 36.7

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	Phenyl urethane	1 Naphthyl urethane	4 Nitro benzoate	3,5 Dinitro benzoate	Hydrogen 3 nitro phthalate	Hydrogen phthalate	Miscellaneous
133	4-Methoxyphenyl methyl carbinol (4 Anisyl methyl carbinol)	310d (cor)		1.557	1.0861 <sup>6</sup>	82.3						Odor of anise Oxid → 4 Methoxy acetophenone 38
134	<i>cis</i> -Octa-9-decen-1-ol (Oleyl alcohol <i>cis</i> -Octadecenyl alcohol)	333.5		1.4607	0.8489	oil	$\beta$ 44.5 al					Allphanate 135 chl 129 chl 4 Nitrophenyl urethane 85 91

\*Derivative data given in order m, p, crystal color, solvent from which crystallized

TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS

b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	1 Naphthyl urethane	4 Nitro benzoate	3,5 Di nitro benzoate	Hydrogen 3 nitro phthalate	Hydrogen phthalate	Pseudo saccharine ether	Miscellaneous
1	1-Phenylethyl alcohol ( <i>d l</i> Methyl phenyl carbinol)	20, 20.1	202	92, 91-2, lgr	106	43 (cor), al	95.93		108 ac a		$n_D^{20}$ 1.5275, $D_4^{20}$ 0.0129
2	<i>trans</i> -2-Methylcyclohexanol	21	167.4	<i>d l</i> 105	<i>d l</i> 155		<i>d l</i> 115				Oxalate <i>d l</i> 61
3	1-Dodecanol ( <i>n</i> -Dodecyl alcohol, Lauryl alcohol)	24, 26	259	74	80	45, 42	60	124 (cor)	50.3 (cor)	54 (cor)	
4	1,1-Dimethyl-2-phenylethanol (Benzyl dimethyl carbinol)	24	216								$n_D^{15}$ 1.5174
5	4-Methoxybenzyl alcohol (4 Anisyl carbinol)	24-5	259	92 (cor)							Benzoate, 38, Me eth, b p 225-6, $n_D^{15}$ 1.5422, $D_4^{15}$ 1.1129
6	Cyclohexanol	25.1	161.1	82	129	50	112.3, al	160	99		$n_D^{15}$ 1.46477, $D_4^{15}$ 0.94155
7	<i>tert</i> -Butyl alcohol (Trimethyl carbinol)	25.5	82.5	136, eth	101	116, al	142, pet eth				$n_D^{20}$ 1.38779, $D_4^{20}$ 0.78670
8	3-Nitrobenzyl alcohol	27	175-80 <sup>3</sup>								Benzoate, 71.2 Ox → 3-nitro benzoic acid 140
9	2,3,3-Trimethylcyclohexanol	28	197								
10	Diethanolamine ( $\beta, \beta'$ -Dihydroxy-diethylamine)	28	270, 217-8 <sup>150</sup>								Picrate, 109-10
11	2,4-Hexadien-1-ol	30.5-1.5	76 <sup>12</sup>	78-9			85				
12	1-Tridecanol	$\alpha$ 30.6, $\beta$ 28.3	155.6 <sup>15</sup>			37.4 (cor)		124 (cor)	52.5	66 (cor)	$D_4^{21}$ 0.8223
13	Cinnamyl alcohol	33	257	90.0-1.5	114	78, 76.5	121				
14	2-Methylbenzyl alcohol (2 Toly carbinol)	36, 35	219	79 (cor)							
15	<i>trans</i> -Octa-9-decen-1-ol (Elaidyl alcohol)	36.7, 35, 34	333, 216 <sup>18</sup>	56-7	71						
16	<i>d, l</i> -Fenchyl alcohol	38-9, $d \alpha$ 45, $l \alpha$ 47, $l \beta$ 3-4	201.5, 201-2	104, $d \alpha$ 82, $l \alpha$ 82	149	109, $\alpha$ 108.9 $\beta$ 94-5, $l \alpha$ 109, $l \beta$ 83	104	95	169, $d \alpha$ 145, $l \alpha$ 146, $l \beta$ 153		
17	1-Tetradecanol (Myristyl alcohol)	39, 37.7	170-3 <sup>20</sup>	74, 71	82	51.2 (cor)	67	123.5 (cor)	60 (cor)	62 (cor)	
18	1,2,2-Trimethylcyclohexanol	41 (+ $\frac{1}{2}$ H <sub>2</sub> O)	81.4-8 <sup>20</sup>								$n_D^{15.4}$ 1.469, $D_4^{15.4}$ 0.9274
19	Pinacol (Tetramethylethylene glycol)	43, 45-6	172								Diacetate, 65, Hydrate, 46
20	<i>l</i> -Menthol	44, 42.5, 35, 33, 31, $d$ 38-40, $d, l$ 34	216	111-2, al, $d, l$ 103-4	119, 126	61-2	153		112, 129-31, ac a		Allophanate, 215
21	1-Pentadecanol	$\alpha$ 44, $\beta$ 38.9		72, bz	72	45.8 (cor)		122.5 (cor)	60.4	72 (cor)	
22	1,3,5-Trimethyl-1-cyclohexen-3-ol	46	87-90 <sup>17</sup>								$n_D^{19.3}$ 1.4735, $D_4^{20.2}$ 0.9132
23	<i>d, l</i> - $\alpha$ -Propylbenzyl alcohol	$d$ 49, $l$ 49	168-70 <sup>100</sup>		99	58			91, 53-4		
24	1,1,1-Trichloroisopropanol	50-1	161.8 <sup>773</sup>								Camphor-like odor
25	1-Hexadecanol (Cetyl alcohol)	50, 49.27	190 <sup>18</sup>	73	82	58.4 (cor), 52	66	122 (cor)	66.8	69.5 (cor)	
26	2,2,6-Trimethylcyclohexanol	51, al	186-7 <sup>753</sup>								$n_D^{20}$ 1.4600, $D_4^{20}$ 0.9128

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point °C	Phenyl urethane	1 Naphthyl urethane	4 Nitro benzoate	3,5 Di nitro benzoate	Hydrogen 3 nitro phthalate	Hydrogen-phthalate	Pseudo saccharine ether	Miscellaneous
27	<b>3,3,5-Trimethylcyclohexanol</b>	<i>trans</i> 52, 37	<i>cis</i> 201-37 <sup>50</sup> , <i>trans</i> 196.5 <sup>70</sup>								Acetate, <i>cis</i> b p 209-10, <i>trans</i> b p 209-10
28	<b>2,2-Dimethyl-1-propanol</b> ( <i>tert</i> -Butyl carbinol, Neopentyl alcohol)	52-3	113	144, lgr	100				71		
29	<b>4-Methylbenzhydrol</b> (Phenyl 4-tolyl carbinol)	53, 58, 42									Ox → Phenyl 4-tolyl ketone, 60
30	<b>1-Heptadecanol</b>	$\alpha$ 54	310		88.5	53.8 (cor)	121.5 (cor)	121.0-8	66.6-7 (cor)	76 (cor)	
31	<b>Piperonyl alcohol</b>	58		102.5							Benzoate, 66, Allophanate, 176.5
32	<b>4-Methylbenzyl alcohol</b> (4-Tolyl carbinol)	59-60	217	79			117.8				
33	<b>1-Octadecanol</b> (Stearyl alcohol)	59.5	210.5 <sup>15</sup>	79-80		64.3 (cor)	66	119 (cor)	72.5 (cor)	74.5 (cor)	
34	<b>1-Nonadecanol</b>	62				58.9			71	80.5	Acetate, 40
35	<b>Eicosanol</b>	65	220 <sup>3</sup>			69.4			77		
36	<b>1-(1-Naphthyl) ethanol</b> ( <i>d,l</i> -Methyl 1-naphthyl carbinol)	66							131-2, bz		
37	<b>1,2-Diphenylethanol</b> ( <i>d,l</i> -Benzyl phenyl carbinol)	67	167 <sup>10</sup>						131 (cor), eth -lt pet		
38	<b>4,4'-Dimethylbenzhydrol</b> (Di-4-tolyl carbinol)	68, al									Carbinyl bromide 48.5-9 lgr
39	<b>Benzhydrol</b> (Diphenyl carbinol)	68, lgr	288, 180 <sup>20</sup>	139.40, bz	135.6, 139	131-2	141		164.5		Acetate 41.2 Benzoate 88-9, al Conc H <sub>2</sub> SO <sub>4</sub> → pa red Tetraacetate, 53
40	<b>1-Glyceryl phenyl ether</b>	69, eth									
41	<b>Erythritol</b> ( <i>d,l</i> -1,2,3,4 Tetrahydroxybutane)	72									
42	<b>Dihydroxyacetone</b> (1,3-Dihydroxy-2-propanone)	72									Diacetate, 48, Di-benzoate, 120.5, 2,4-Dinitrophenyl-hydrazone, 277-8
43	<b>2-Nitrobenzyl alcohol</b>	74	270-165 <sup>20</sup>								Benzoate, 101-2
44	<b>1,10-Decanediol</b> (Decamethylene glycol)	75.5, 72									1,10-Dibromide, 27.4 b p 162.5 <sup>10</sup>
45	<b>2,2,2-Tribromoethanol</b>	80	92-3 <sup>10</sup>								Urethane, 86-7
46	<b>10-Nonadecanol</b> (Myrcyl alcohol)	85		96	54						
47	<b>Phenacyl alcohol</b> ( $\alpha$ -Hydroxyacetophenone, Benzoyl carbinol)	86	118-20 <sup>11</sup>			128.6					Benzoate, 118.5, 3-Nitrobenzoate, 104.5
48	<b><i>n</i>-Triacontanol</b> (1-Hydroxytriacontane)	86.5, bz									Acetate, 69, pet eth
49	<b>2-Hydroxybenzyl alcohol</b> (Saligenin)	86-7									2-Benzoate, 66
50	<b><i>d</i>-Sorbitol</b>	89-93, 112 (anh)									Hexaacetate, 99, Hexabenzoate, 216-7, et ac
51	<b>3-Nitrophenacyl alcohol</b> (3-Nitrobenzoyl carbinol)	92.5-30, pa yel									Acetate, 53, eth -lgr, Semicarbazone, 214, al

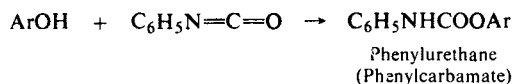
\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Phenyl-urethane	1 Naphthyl urethane	4-Nitrobenzoate	3,5-Dinitrobenzoate	Hydrogen 3-nitrophthalate	Hydrogenphthalate	Pseudo saccharine ether	Miscellaneous
52	<b>4-Nitrobenzyl alcohol</b>	93	185 <sup>12</sup>								Acetate, 78, Benzoate, 94 5
53	<b>4,4',4''-Trimethyltriphenyl carbinol</b> (Tris- <i>p</i> -tolyl carbinol)	96									Et eth 111 pet eth H <sub>2</sub> SO <sub>4</sub> → gr - red
54	<i>meso</i> -Erythritol	121, 120 (cor)	330								Tetraacetate 85 89 Dibenzyldiene, 201-2
55	<b>4-Nitrophenacyl alcohol</b> (4-Nitrobenzoyl carbinol)	121									Acetate, 124, et ac -lgr, Phenylhydrazone, 178, bz
56	<i>d l</i> -Benzoin (Benzoyl phenyl carbinol)	137, 133	344	165	140	123					4 Nitrophenylurethane 183 Acetate, 83
57	<b>Cinchol</b> ( $\beta$ -Sitosterol)	137					202 4				Acetate, 134, Benzoate, 145
58	<b>Furoin</b> (Furoyl furyl carbinol)	138 9 (cor), 135									Acetate, 76-7 Benzoate, 92-3
59	<b>Cholesterol</b> (anh) ( <i>l</i> -Cholesterol)	148 5	360d	168	176	185 190 3			161		4-Nitrophenylurethane, 205 Benzoate, 151-2 Acetate, 87 8
60	<b>Triphenylmethanol</b> (Triphenyl carbinol)	161 2, bz	380								
61	<b>Ergosterol</b>	165		185	202		202, chl				Acetate, 176, 180, eth, Benzoate, 168
62	<i>d</i> -Mannitol	166, <i>l</i> 163-4, <i>d l</i> - $\alpha$ 168		303							Hexaacetate, 126, eth, Benzoate, 149-50, 147-8, al
63	<b>1,1,1-Tribromo-<i>tert</i>-butyl alcohol</b> (Brometone)	167-76, w -al									Acetate, 43 4, al, Benzoate, 27, al
64	<b>Dulcitol</b> (1,2,3,4,5,6-Hexanehexol)	188 5									Hexaacetate, 171, 168 9, abs al, Hexabenzoate, 189-91, eth -chl
65	<b>4,4',4''-Triaminotriphenyl carbinol</b> (Pararosaniline base)	205									4 4,4'' Triacetyl, 192 acet-eth Me eth 105, eth, 135, bz
66	<i>d</i> -Borneol ("Borneo camphor")	208, 205, <i>d l</i> 210 5	212	138-9	132, <i>iso</i> 130, 127	153, <i>d l</i> 134, 137	154 5		161 4, ac a, 165 (cor)		
67	<i>meso</i> -Inositol (1,2,3,4,5,6-Hexahydroxycyclohexane)	225 (cor), 218					86, al				Hexaacetate, 212, subl, tol, Hexabenzoate, 258, al
68	<i>d</i> -Quercitol (Pentahydroxycyclohexane)	232, 234									Pentabenzoate, 155
69	<b>Pentaerythritol</b> (2,2-Bishydroxymethyl-1,3-propanediol)	262 253									Tetraacetate, 84, wh, al, Tetra- benzoate, 99-101, al

\*Derivative data given in order m p, crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE VII

*Phenylurethane*

From the phenol with phenylisocyanate without solvent

For directions and examples see Linstead, pp 34-35, J B McKinley, J E Nickels and S S Sidue, *Ind Eng Chem, Anal Ed*, **16**, 304 (1944)

From the phenol with phenylisocyanate in kerosene

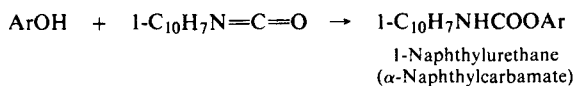
See Cheronis, p 489

From the phenol with phenylisocyanate and a catalytic amount of pyridine

See Shriner, p 265

From the phenol with phenylisocyanate in toluene

See O L Brady and J Harris, *J Chem Soc*, **127**, 2175 (1925)

*1-Naphthylurethane ( $\alpha$ -Naphthylcarbamate) \**

From the phenol with 1-naphthylisocyanate without solvent

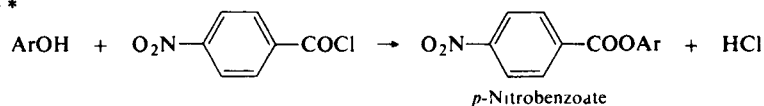
For directions and examples see Cheronis, p 488, Linstead, pp 34-35, Vogel, p 683, Wild, p 68

From the phenol with 1-naphthylisocyanate and a catalytic amount of pyridine, triethylamine or trimethylamine in ether

See Shriner, p 211, Vogel, p 683, Wild, p 68, H E French and A F Wirtel, *J Amer Chem Soc*, **48**, 1736 (1926)

From the phenol with 1-naphthylisocyanate and a catalytic amount of a tertiary aliphatic amine in petrol ether

See Cheronis, p 488, Vogel, p 684

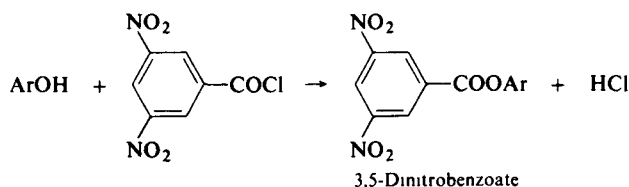
*p-Nitrobenzoate \**

From the phenol with *p*-nitrobenzoyl chloride in pyridine

For directions and examples see Vogel, p 682, Wild, p 52

From the phenol with *p*-nitrobenzoyl chloride without solvent

See Wild, p 52

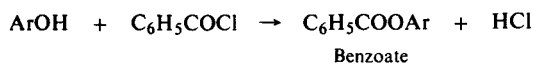
*3,5-Dinitrobenzoate \**

From the phenol with 3,5-dinitrobenzoyl chloride in pyridine

For directions and examples see Cheronis, p 486, Vogel, p 682, Wild, p 65, R C Brown and R E. Kremers, *J Amer Pharm Ass*, **11**, 607 (1922), M Phillips and G L Keenan, *J Amer Chem Soc*, **53**, 1924 (1931)

From the phenol with 3,5-dinitrobenzoyl chloride without solvent

See Shriner, pp 212-213

*Benzoate*

From the phenol with benzoyl chloride in aqueous sodium hydroxide

For directions and examples see Cheronis, pp 481-482, 487, Linstead, p 20, Wild, p 65

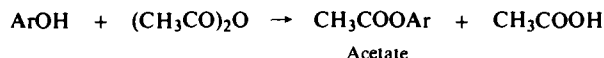
\*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLE VII (Continued)

From the phenol with benzoyl chloride in pyridine  
 See Linstead, p 19

### Acetate



From the phenol with acetic anhydride in aqueous sodium hydroxide

For directions and examples see Linstead, p 21, Vogel, p 682, Wild, p 64, F D Chattaway, *J Chem Soc*, 2495 (1931)

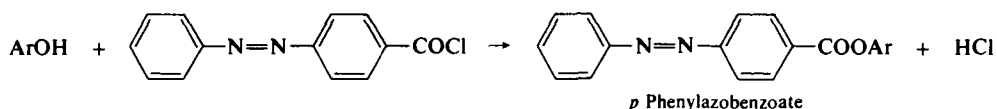
From the phenol with acetic anhydride and sodium acetate

See Linstead, p 21, Wild, p 64

From the phenol with acetic anhydride and a catalytic amount of sulfuric acid

See Cheronis, p 487

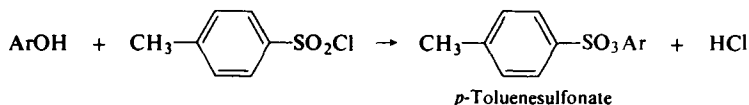
### *p*-Phenylazobenzoate



From the phenol with *p*-phenylazobenzoyl chloride in pyridine

For directions and examples see Cheronis, p 486, E O Woolfolk and J M Taylor, *J Org Chem*, 22, 827 (1957)

### *p*-Toluenesulfonate



From the phenol with *p*-toluenesulfonyl chloride in pyridine

For directions and examples see Linstead, p 20, Vogel, p 684, Wild, p 66

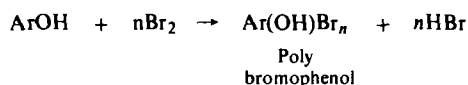
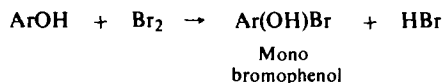
From the phenol with *p*-toluenesulfonyl chloride in aqueous sodium hydroxide

See Linstead, p 20

From the phenol with *p*-toluenesulfonyl chloride and sodium hydroxide in aqueous acetone

See Wild, p 66

### Bromo derivative \*



From the phenol in aqueous methanol, in ethanol, in acetone or in dioxane with bromine in aqueous potassium bromide

For directions and examples see Cheronis, p 490, Shriner, p 264

From the phenol in aqueous hydrochloric acid with bromine in water

See Linstead, p 19

From the phenol in glacial acetic acid and bromine

See Wild, p 73

From the phenol with bromine in carbon disulfide

See Vogel, p 679

For a discussion on the effect of solvents in the bromination of phenols

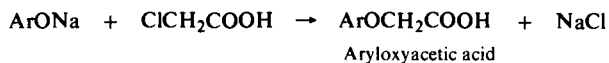
See N D Cheronis, *Micro and Semimicro Methods (Technique of Organic Chemistry)*, Vol 6, Interscience, New York, 1954, pp 286-287

### \*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLE VII (Continued)

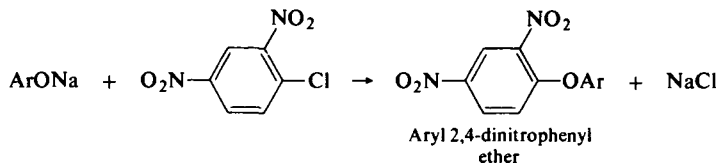
*Aryloxyacetic acid.\**



From the phenol in aqueous sodium hydroxide with aqueous chloroacetic acid.

*For directions and examples see:* Cheronis, pp. 489-490; Linstead, p. 20; Shriner, p. 264; Vogel, p. 683; Wild, p. 72; C. F. Koelsch, *J. Amer. Chem. Soc.*, **53**, 304 (1931); N. V. Hayes and G. E. K. Branch, *J. Amer. Chem. Soc.*, **65**, 1555 (1943).

*Aryl 2,4-dinitrophenyl ether.*



From the phenol in aqueous sodium hydroxide with 2,4-dinitrochlorobenzene in alcohol.

*For directions and examples see:* Cheronis, pp. 490-491; Vogel, p. 684; Wild, p. 71; R. W. Bost and F. Nicholson, *J. Amer. Chem. Soc.*, **57**, 2368 (1935).

From the phenol with 2,4-dinitrochlorobenzene and aqueous potassium hydroxide.

*See:* Linstead, pp. 20-21.

**NOTE:** For additional information regarding directions and examples for the preparation of derivatives of phenols which are similar to those of alcohols (e.g., 1-naphthylurethanes, 3,5-dinitrobenzoates, etc.) see explanations and references to Table VI, p. 77, 78, 79.

\*Derivatives recommended for first trial.

**WARNING:** This is not an instruction manual. References should be consulted for the preparation of derivatives.



**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**a) Liquids. (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Phenyl-urethane	$\alpha$ -Naphthyl-urethane	$p$ -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	$p$ -Toluene sulfonate	Miscellaneous
1	<b>2-Chlorophenol</b>	175.6	7	1.5473 <sup>40</sup>	1.2410 <sup>15</sup>	121	120	115	143	mono 48.9, di 76	74	Aryloxyacetic acid, 145, 2,4-Dinitrophenyl ether, 99, 4,6-Bis(dimethylamino-methyl) deriv., 62, 3, $p$ -Phenylazobenzoate, 120-1
2	<b>2-Bromophenol</b>	195	5		1.4924		129			95	78	$p$ -Phenylazobenzoate, 126-7
3	<b>2-Chloro-4-methylphenol</b> (2-Chloro- $p$ -cresol)	195.6		1.5200 <sup>2</sup>	1.1785 <sup>27</sup>							Benzoate, 71, 2, Aryloxyacetic acid, 108, Acetate, b p 238
4	<b>2-Hydroxybenzaldehyde</b> (Salicylaldehyde)	197 (corr)	1.6	1.574	1.1690 <sup>28</sup>	133		128			63.4	Aryloxyacetic acid, 132, Acetate, 39
5	<b>3-Methylphenol</b> ( $m$ -Cresol)	203	12	1.540	1.03401	125, 121.2, al -lgr	127.8	90	165.4 (corr), al	tri 84	51	Aryloxyacetic acid, 103, 2,4-Dinitrophenyl ether, 74, Benzoate, 55
6	<b>2-Ethylphenol</b>	207			1.0371 <sup>0</sup>	143.4, 141		56.7	108			Aryloxyacetic acid, 141, Benzoate, 38-9, al
7	<b>2-Isopropylphenol</b>	212	16	1.5315	1.012							Aryloxyacetic acid, 132.3, Methyl urethane, 96.7, 4,6-Dinitro deriv., 53
8	<b>2-Bromo-4-ethylphenol</b>	213.4									121	
9	<b>3-Ethylphenol</b>	217	-4		1.0250 <sup>9</sup>	137, 138.8		68				Aryloxyacetic acid, 77, Benzoate, 52, 95% al
10	<b>2-Allylphenol</b>	220	-6	1.5181	1.0255 <sup>15</sup>	116, 106.0, 6.5				6-mono 50		Aryloxyacetic acid, 148.5-50
11	<b>2-Chloro-4,6-dimethylphenol</b>	221.3				129.30		94-5				
12	<b>Methyl salicylate</b> (Methyl 2-hydroxybenzoate)	224	-8	1.5369	1.184	117, bz		128				Acetate, 52, Benzoate, 92, al
13	<b>2-Propylphenol</b>	224.6-6.6, 220.0-0.5		1.5280	1.000 <sup>15</sup>	111, formic a			96			Aryloxyacetic acid, 99-100
14	<b>2-sec-Butylphenol</b>	227-8, 116 <sup>21</sup>	12-3	1.5288	0.9876	86, lgr						Aryloxyacetic acid, 109.5-110
15	<b>4-Allylphenol</b>	230-1 <sup>750</sup>	16	1.5441 <sup>18</sup>	1.033 <sup>18</sup>				103.0-3.5			Urethane, 122.3, Acetate, b p 238-9
16	<b>Ethyl salicylate</b> (Ethyl 2-hydroxybenzoate)	234	1.3	1.5226	1.131	98.100		107-8, yell, bz				Benzoate, 79-80, 87, al, 3,5-Dinitro deriv., 92-3
17	<b>2-n-Butylphenol</b>	234-7, 113, 5 <sup>14</sup>		1.5180 <sup>25.5</sup>	0.975				97			Aryloxyacetic acid, 104-5, Acetate, 105.5
18	<b>4-Isobutylphenol</b>	236, 235-9		1.5319 <sup>25</sup>	0.9796 <sup>28</sup>							Aryloxyacetic acid, 124-5
19	<b>Carvacrol</b> (5-Isopropyl-2-methylphenol)	237.8	1	1.524	0.9760	134.5, 138	116, lgr	51	83, 76-7	46		Aryloxyacetic acid, 151, $p$ -Xenylurethane, 116, al
20	<b>Isopropyl salicylate</b> (Isopropyl 2-hydroxybenzoate)	240-2		1.50650	1.0729							3,5-Dinitro deriv., 101.2, al

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**a) Liquids. (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Phenyl-urethane	$\alpha$ -Naphthyl-urethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Miscellaneous
21	<b>3-Methoxyphenol</b> (Resorcinol monomethyl ether)	243-244	-17.5				128.9			<i>tri</i> 104		Aryloxyacetic acid, 118, 111-3, w, 2,4-Dinitrophenyl ether, 87-8
22	<b>2-Allyl-6-methoxyphenol</b>	250-1115 <sup>9</sup>		1.5393				96.7				
23	<b>4-Allyl-2-methoxyphenol</b> (Eugenol)	254.8, 127 <sup>15</sup>	-9.1, 16.9	1.5410	1.0664	95.5	122, lgr	81	130.8 (cor), al	<i>tetra</i> 118	85	Acetate, 29, al, Benzoate, 70, al, Aryloxyacetic acid, 81, 100, 2,4-Dinitrophenyl ether, 115, N,N-Diphenylurethane, 108
24	<b>Isobutyl salicylate</b> (Isobutyl 2-hydroxybenzoate)	260.2		1.50872	1.0639							3,5-Dinitro deriv, 72.3, al
25	<b><i>d,l</i>-1,2,3,4-Tetrahydro-2-naphthol</b>	264 <sup>716</sup>		1.5523 <sup>17</sup>	1.0715 <sup>17</sup>	99						Acetate, b p 169 <sup>34</sup> , Benzoate, b p 254.5 <sup>40</sup>
26	<b>2-Methoxy-4-propenylphenol</b> (Isoeugenol)	267.5		<i>cis</i> 1.5700, <i>trans</i> 1.5782	<i>cis</i> 1.0851, <i>trans</i> 1.0852	<i>cis</i> 118, <i>trans</i> 152	149.50, lgr	109	154.8 (cor), <i>n</i> -BuOH			Acetate, 79-80, bz-lgr, Benzoate, <i>cis</i> , 68, <i>trans</i> , 103.4, al, Aryloxyacetic acid, 116 (94), 2,4-Dinitrophenyl ether, 128
27	<b><i>n</i>-Butyl salicylate</b> ( <i>n</i> -Butyl 2-hydroxybenzoate)	270-2, 259-60	-5.9	1.51148	1.0728							3,5-Dinitro deriv, 60.1, al, <i>p</i> -Nitrobenzyl ether, 92
28	<b>Isoamyl salicylate</b> (Isopentyl salicylate)	276.8		1.50799	1.0535							3,5-Dinitro deriv, 61-2, al
29	<b>3-Acetoxyphenol</b> (Resorcinol monoacetate)	283		1.5328								Saponification → resorcinol, 110 + ac a, Diacetate, b p 130.1 <sup>7</sup>

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point °C	Phenyl urethane	$\alpha$ -Naphthylurethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
1	2-Benzylphenol (2-Hydroxydiphenylmethane) (Labile form)	21, stable 52, 54	312	117-8								Me eth, 30, Urethane, 110-1
2	4- <i>n</i> -Propylphenol	22	232	129			123			b p 245 6 <sup>745</sup>	38	$n_D^{20}$ 1.5220
3	4- <i>n</i> -Butylphenol	22	248, 138-9 <sup>18</sup>	115, al		67-8, yel al	92			b p 138- 41 <sup>15</sup>	27	$n_D^{20}$ 1.5165, $D_4^{20}$ 0.978, Aryloxyacetic acid, 81
4	4- <i>n</i> -Amylphenol (4- <i>n</i> -Pentylphenol)	23	248-53								51 0 0 5, al	$n_D^{20}$ 1.5272, $D_4^{20}$ 0.9621, Aryloxyacetic acid, 90
5	3- <i>n</i> -Propylphenol	26	228				75 (117-8)					$n_D^{20}$ 1.5223, $D_4^{20}$ 0.9887, Aryloxyacetic acid, 96-7, lgr
6	2-Chloro-3,4-dimethylphenol	27, pet eth									87, aq al	
7	2,4-Dichloro-3-methylphenol (2,4-Dichloro- <i>m</i> -cresol)	27	240 5- 2 5						92 0 2 5, al		90 5	Benzenesulfonate, 70, al
8	2,4-Dimethylphenol ( <i>m</i> -4-Xylenol)	27 8	211 5 (cor)	103, 112, CCl <sub>4</sub>	135	102, 105	164 6 (cor), 95% al				37 8, ac a	$n_D^{20}$ 1.5420, $D_4^{20}$ 1.0276, <i>p</i> -Xenylurethane, 184, Aryloxyacetic acid, 141, <i>p</i> -Phenylazobenzoate, 110-3 2,4-Dinitrophenyl ether, 102-3
9	2-Ethoxyphenol	28	217								31	Allophanate, 212
10	2-Acetylphenol (2-Hydroxyacetophenone)	28	215							89, al	87 8, al	$n_D^{20}$ 1.5590, $D_4^{20}$ 1.131, Semicarbazone, 210, Oxime, 118, Phenylhydrazone, 110
11	2-Methylphenol ( <i>o</i> -Cresol)	31	191-2	141, 143	141 2, lgr	94	138 4 (cor), al	<i>di</i> 56	54 5, pyr			Aryloxyacetic acid, 152, <i>p</i> -Phenylazobenzoate, 110-11 5, 2,4-Dinitrophenyl ether, 90, <i>N,N</i> -Diphenylurethane, 73
12	2-Methoxyphenol (Guaiacol)	32, 28 2	205	136, al	118	93	141 2 (cor), al	4,5,6- <i>tri</i> 116, al	85, lgr		57 8	$n_D^{20}$ 1.5441, $D_4^{20}$ 1.1287, Aryloxyacetic acid, 116, 2,4-Dinitrophenyl ether, 97
13	5-Fluoro-2-nitrophenol	32, lgr									110 11	Me eth, 52, lgr
14	3-Bromophenol	33	236		108				52 4	b p 149 <sup>40</sup>	86	Aryloxyacetic acid, 108, <i>p</i> -Phenylazobenzoate, 125-6
15	3-Chlorophenol	33	214		158	99	156				71	Aryloxyacetic acid, 110, 2,4-Dinitrophenyl ether, 75, <i>p</i> -Phenylazobenzoate, 127-8
16	2-Bromo-4-chlorophenol	33-4	123 <sup>10</sup>								99-100	Aryloxyacetic acid, 139-40

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthylurethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous	
17	4-Methylphenol ( <i>p</i> -Cresol)	36	202	115	146	98	188.6 (cor), al	<i>di</i> 49, <i>tetra</i> 198-9, al	69-70, al		70	<i>p</i> -Phenylazobenzoate, 134.5-6.5, N,N-Diphenylurethane, 94, <i>p</i> -Xenylurethane, 198	
18	2,4-Dibromophenol	36, 40	238-9						120	36	97.5	Aryloxyacetic acid, 153, 2,4-Dinitrophenyl ether, 135, Me eth, 61.3, b p 272, Et eth, 53.5	
19	4-Methyl-2-nitrophenol (2-Nitro- <i>p</i> -cresol)	36.5, yel, w-al	125 <sup>22</sup>				192				100-1	Me eth, 8.5, pa yel, b p 274, Et eth, b p 275.85 d	
20	4-Chlorophenol	37, 43	217	148.5	166	171	186	2-mono 33.4, 2,6- <i>di</i> 90	71	7.8	88	Aryloxyacetic acid, 156, 2,4-Dinitrophenyl ether, 126, <i>p</i> -Phenylazobenzoate, 153-4, N,N-Diphenylurethane, 97	
21	2,4-Diethylphenol	37-8	219	170.1								Aryloxyacetic acid, 67-8	
22	3-Fluoro-2-nitrophenol	39, lgr									114	Me eth, 43.5, lgr	
23	2,6-Dichloro-4-methylphenol (2,6-Dichloro- <i>p</i> -cresol)	39, 42	120-5 <sup>11</sup>							48	9	NH <sub>4</sub> salt, 125, Me eth, b p 234	
24	3-Ethoxyphenol (Resorcinol monoethyl ether)	40	246-7, pa yel, 254-8				183.5					97.5	2,4-Dinitrophenyl ether, 114-5, Picrate, 105-6, red, chl
25	3-Iodophenol	40		138								72-3, pet eth	Aryloxyacetic acid, 115
26	2-Benzoylphenol (2-Hydroxybenzophenone)	41					124						<i>p</i> -Nitrobenzyl ether, 124.5, acet, Phenylhydrazone, 155, Semicarbazone, 250-1, Oxime, 141.3
27	3-Methyl-2-nitrophenol (2-Nitro- <i>m</i> -cresol)	41, yel, pet eth								59, al	79, al	Me eth, 54, yel, al	
28	Phenol	41.8, 42	182, 183	126, bz	132.3, lgr	127, bz	145.8 (cor), al	<i>tri</i> 95	95.6, al		69	Aryloxybenzoic acid, 99, <i>p</i> -Phenylazobenzoate, 148-50, <i>p</i> -Xenylurethane, 173, N,N-Diphenylurethane, 105	
29	3-Fluoro-4-nitrophenol	42, w or lgr	173 <sup>12</sup>									118	Me eth, 56.5
30	Phenyl salicylate (Salol, Phenyl 2-hydroxybenzoate)	42, 38.8, 28.5 (three forms)		111-2, bz, 242			111			99.5	81	N,N-Diphenylurethane, 144	

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthylurethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
31	<b>2-Iodophenol</b>	43	186-7 <sup>160</sup>	122						98 101	34, pet eth	D <sup>80</sup> 1 8757 Aryloxyacetic acid, 135 <i>p</i> -Phenylazobenzoate 126 8 2,4 Dinitrophenyl ether, 95
32	<b>5-Bromo-2-nitrophenol</b>	44 yel								74 5		Me eth, 85 5 Et eth, 79 5 80 5, al
33	<b>2,4-Dichlorophenol</b>	45	210				142-3	68	125		97	Aryloxyacetic acid, 141, 135, $\beta$ -Naphthylurethane, 166, 2,4-Dinitrophenyl ether, 119
34	<b>2-Nitrophenol</b>	45, yel, al	216		113	141	155	<i>di</i> 117	83	40 1, lgr	59	D <sup>40</sup> 1 2942, Aryloxyacetic acid, 158, 2,4-Dinitrophenyl ether, 142, N,N-Diphenylurethane, 114, <i>p</i> -Phenylazobenzoate, 136 5 7 0
35	<b>5-Chloro-2-hydroxybiphenyl</b>	46									88	
36	<b>2-Chloro-5-methylphenol</b> (6-Chloro- <i>m</i> -cresol)	46	196						96	<i>b p</i> 122-3 <sup>11</sup>	31 40	Benzenesulfonate, 99
37	<b>4-Bromo-5-isopropyl-2-methylphenol</b>	46, lgr				53 4						Me eth, <i>b p</i> 147 50 <sup>15</sup>
38	<b>2-tert-Butyl-5-methylphenol</b> (6- <i>tert</i> -Butyl- <i>m</i> -cresol)	46-7	127 <sup>11</sup>							<i>b p</i> 139 <sup>17</sup>		Me eth, 22, <i>b p</i> 225 7
39	<b>3-Chlorocatechol</b> (3-Chloro-1,2-dihydroxybenzene)	46-8, 48 50	110 11 <sup>11</sup>								110-11	2-Me eth, 31 5 3 0
40	<b>4-Ethylphenol</b> (4-Hydroxyethylbenzene)	47	219	120	128	80 1	132-3				59 60, al	n <sup>25</sup> 1 5239, D <sup>20</sup> 1 0123 Aryloxyacetic acid, 97, <i>p</i> -Phenylazobenzoate, 117-8
41	<b>3-Methyl-2,4,6-trichlorophenol</b> (2,4,6-Trichloro- <i>m</i> -cresol)	47, w	265						92 3	35, 32, eth	53	
42	<b>4-Chloro-2-methylphenol</b> (4-Chloro- <i>o</i> -cresol)	48	222-5								71	Aryloxyacetic acid, 115 7, Me eth, <i>b p</i> 213 5
43	<b>2,6-Dibromo-4-methylphenol</b> (2,6-Dibromo- <i>p</i> -cresol)	49, 54				141 2				67	94 5	
44	<b>Thymol</b> (2-Isopropyl-5-methylphenol)	49 7, 51 5, acet	233 5	107, aq al	160, lgr	70	103 2, al	55	71	<i>b p</i> 242 3	33	Aryloxyacetic acid, 149, 2,4-Dinitrophenyl ether, 67, <i>p</i> -Xenylurethane, 194, <i>p</i> -Phenylazobenzoate, 85 6

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthylurethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
45	2-Hydroxy-4-methoxyacetophenone (Peonol)	52 3, al								46 5		$n_D^{20}$ 1.54322, $D^{20}$ 1.310, <i>m</i> -Nitrobenzoate, 109, <i>p</i> -Nitrophenylhydrazone, 238 9, ac a
46	2-Benzylphenol (2-Hydroxydiphenylmethane) (stable form)	52 54, labile 21-2	312	117 5-8 0, lgr								Benzyl eth, 38, me al
47	2-Chloro-3-methylphenol (2-Chloro- <i>m</i> -cresol)	55 6 49 50	194						96		55 6	Benzenesulfonate, 58
48	4-Methoxyphenol (Hydroquinone monomethyl ether)	56 55	243 4							32	87, al	Aryloxyacetic acid, 110-2
49	3-Methyl-6-nitrophenol (6-Nitro- <i>m</i> -cresol)	56, yel, bz								48, al	77	Me eth, 62, Et eth, 55, pet eth, 50-1
50	3-Bromo-4-methylphenol (3-Bromo- <i>p</i> -cresol)	56	245								75	Me eth, b p 103-5 <sup>10</sup>
51	2-Phenylphenol (2-Hydroxybiphenyl)	56, 67 5 (cor)	275						64 6, dil al	62 5 3 pet eth	75-6	<i>p</i> Phenylazobenzoate, 141 4, 2,4-Dinitrophenyl ether, 113-4
52	2,6-Dibromophenol	56-7	162 <sup>21</sup>					93 3		46	68	Me eth, 13, b p 143-5 <sup>34</sup> , Et eth, 40 6
53	4- <i>n</i> -Caproylresorcinol	56 7, tol - pet eth	343 5 d			89 91 pa yel, al						
54	2-Bromo-4-methylphenol (2-Bromo- <i>p</i> -cresol)	56 7	213-4, 102 4 <sup>20</sup>						121	b p 120 <sup>4</sup>		$D_{41}^{25}$ 1.547
55	5-Bromo-3-methylphenol (5-Bromo- <i>m</i> -cresol)	56-7, 54								83		Me eth, b p 139 40 <sup>20</sup> , Picrate, 130
56	2-Cyclohexylphenol	56 7										4,6-Dinitro deriv, 106, al, 2,4-Dinitrophenyl ether 76 7
57	2,3-Dichlorophenol	56 7	206					<i>di</i> 90				Me eth, 31
58	4,6-Dibromo-2-methylphenol (4,6-Dibromo- <i>o</i> -cresol)	57				136 7					62	
59	3-Hydroxy-6-nitrobiphenyl	57 8, bz				135	171					2,4-Dinitrophenyl ether, 131 4-Nitro deriv, 176-8
60	2,3,6-Trichlorophenol	58, pet eth									90, al	
61	2,6-Dichloro-3-methylphenol (2,6-Dichloro- <i>m</i> -cresol)	58	234						100-1, al		78 0 8 5, al	
62	2,5-Dichlorophenol	58-9, pet eth	212								69	
63	4-Propylcatechol (1,2-Dihydroxy-4-propylbenzene)	60, bz	175-80 <sup>30</sup>									3-Me eth, b p 240-2, Di-me eth, b p 247
64	1,2-Dihydroxynaphthalene (1,2-Naphthalenediol)	60 (hyd), 103-4 (anh)									<i>di</i> 106	
65	4-Isopropylphenol	61	223-5								71-2	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthylurethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
66	5,6,7,8-Tetrahydro-2-naphthol	61.5-2.5	275 <sup>70s</sup>			113, 106.5				b p 158 <sup>14</sup>	96	N,N-Diphenylurethane, 114, Cinnamate, 77.5
67	2,3,5-Trichlorophenol	62 (hyg)									103, lgr	Me eth, 84, al
68	2-Methyl-3,5,6-trichlorophenol (3,5,6-Trichloro- <i>o</i> -cresol)	62, ac a									110, al	
69	3,4-Dimethylphenol ( <i>o</i> -4-Xylenol)	62.5, w	225 <sup>757</sup>	120, dil al	141.2, lgr		181.6 (cor), al	tri 171		22	58.5	Aryloxyacetic acid, 162.5, 2,4-Dinitrophenyl ether 105-6, <i>p</i> -Xenylurethane, 183, al Picrate, 83.8, yel Me eth, 204.5, <i>p</i> -Phenylazobenzoate, 104-7
70	2,6-Dinitrophenol	63-4							135			Picrate, 122, Me eth, 118
71	4-Bromo-3-methylphenol (4-Bromo- <i>m</i> -cresol)	63.5, pet eth	118-23 <sup>7</sup>						84.5		83.5	Benzenesulfonate, 79-80, Me eth, b p 108.5 <sup>12</sup>
72	4-Bromo-2-methylphenol (4-Bromo- <i>o</i> -cresol)	64	235 (subl)							b p 132 <sup>12</sup>	67.8	Et eth, b p 238-40
73	1-Acetyl-2-naphthol	64, lgr									85.6, pyr	
74	4-Bromophenol	64, 66.4	238	140	169	180	191	tri 171		22	58.5	Aryloxyacetic acid, 157, 2,4-Dinitrophenyl ether, 141, N,N-Diphenylurethane, 99, <i>p</i> -Phenylazobenzoate, 167.5-8.5
75	2-Methyl-1-naphthol	64-5								81.2	94-5	Picrate, 133-4
76	4-Methylcatechol (3,4-Dihydroxytoluene)	65, bz	252	di 166						di b p 260-4	di 58	Diaryloxyacetic acid, 58, Di- <i>p</i> -xenylurethane, 193
77	3-Bromo-2-nitrophenol	65-7, pet eth (anh), 35 (hyd), w							136.5-7.5, al		133	Me eth, 73
78	4-Chloro-3-methylphenol (4-Chloro- <i>m</i> -cresol)	66, 55	235		153-4				98		86	2,4-Dinitrophenyl ether, 112, Benzenesulfonate, 66
79	4-Hydroxy-3-nitrophenyl	66								85-6, lgr	111	Me eth, 91-2
80	4-Methyl-2,3,5-trichlorophenol (2,3,5-Trichloro- <i>p</i> -cresol)	66-7, ac a								37-8, w-ac a	89, w-al	
81	2,6-Dichlorophenol	67	219-20, 80-5 <sup>4</sup>								74.0-4.5	Me eth, b p 105-6 <sup>20</sup>
82	3,5-Dimethylphenol ( <i>m</i> -5-Xylenol)	68	219.5 (subl)	148, 151		109	195.4 (cor), al	tri 166	83, ac a	b p 130 <sup>28</sup>	24	Aryloxyacetic acid, 111, 81, 2,4-Dinitrophenyl ether, 100, <i>p</i> -Phenylazobenzoate, 104.5-6.5, <i>p</i> -Xenylurethane, 150
83	2-Bromo-6-nitrophenol	68, yel								39.5-40		Me eth, 67

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	$\alpha$ Naphthyl urethane	<i>p</i> -Nitro benzoate	3,5-Di-nitro benzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous	
84	3-Methylcatechol (2,3-Dihydroxytoluene)	68, bz										2-Me eth , 39, b p 204, Di-Me eth , b p 202-3	
85	3,5-Dichlorophenol	68	233					<i>tri</i> 189	116	38	55	Me eth , 35, ac a , Et eth , 41-2, ac a	
86	2,6-Di-iodophenol	68								107, ac a	92 3, al	Aryloxyacetic acid, 157, Me eth , 77-5, al	
87	2,4,5-Trichlorophenol	68, pet eth										Me eth , b p 124 <sup>10</sup> , Et eth , b p 259 <sup>705</sup>	
88	5,6,7,8-Tetrahydro-1-naphthol	68 5-9 0, 74-5	264 5-5 0							73 5	46	2,4-Dinitrophenyl ether, 140-1	
89	2-Bromo-4,6-dichlorophenol	68 9	268 d						82-3				
90	2-Bromo-4-methyl-6-nitrophenol (2-Bromo-6-nitro- <i>p</i> -cresol)	69, yel							128	110-11			
91	2,4,6-Trichlorophenol	69 5, ac a , 68	245			105 6					b p 261-2	75 5, al	Aryloxyacetic acid, 182 6, 2,4-Dinitrophenyl ether, 136, N,N-Diphenylurethane, 143, Me eth , 61-2, al , Et eth , 43-4
92	2,4,6-Trimethylphenol	70, 69	220	141-2 lgr				<i>di</i> 158			62, pet eth	108	Aryloxyacetic acid, 142
93	2,3,4,6-Tetrachlorophenol	70	150 <sup>15</sup>							65 6			Me eth , 64-5, Et eth , 55, Benzene-sulfonate, 127
94	1-Chloro-2-naphthol	70, lgr , 72								42 3	99 100		Me eth , 70-1, Et eth , 58
95	Methyl 3-hydroxybenzoate	70	280	115-6, bz									
96	2-Methyl-6-nitrophenol (6-Nitro- <i>o</i> -cresol)	70, w -al							66, al		42, al		Me eth , 30, pet eth , Et eth , b p 249 50, yel
97	3-Propylcatechol (1,2-Dihydroxy-3-propylbenzene)	70-2, pet eth											3-Me eth , b p 144-6 <sup>25</sup> , Di-Me eth , b p 134-7 <sup>22</sup>
98	2,4,5-Trimethylphenol (Pseudocumenol)	71	232	110				35		34 0-4 5, pet eth	63, al		Aryloxyacetic acid, 132, <i>p</i> -Xenylurethane, 196
99	4,6-Dichloro-3-methylphenol (4,6-Dichloro- <i>m</i> -cresol)	72	235-6, 110 <sup>18</sup>						104-5, al		57 5, al		n <sup>o</sup> 1 5722, Benzenesulfonate, 86, al
100	2,4-Di-iodophenol	72, w							165-7 (cor)	70-1, w -al	98		Me eth , 68, w -al , Et eth , 46, me al , 51
101	2-Chloro-4,5-dimethylphenol	72									43		
102	3,5-Dimethylcatechol (4,5-Dihydroxy- <i>m</i> -xylene)	73-4, w								<i>di</i> 161, ac a			4-Me eth , b p 227-8

\*Derivative data given in order m p , crystal color, solvent from which crystallized



**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point, °C	Phenylurethane	$\alpha$ -Naphthylurethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
103	<b>5-Chloro-2-methylphenol</b> (5-Chloro- <i>o</i> -cresol)	73.4	225					<i>tri</i> 190	110		53.4	Me eth., b p 206-8, Et eth., b p 210-20
104	<b>2,5-Dibromophenol</b>	73.4							110			
105	<b>3-Iodo-2-nitrophenol</b>	73.5, w								102.5		Me eth., 83-4
106	<b>Ethyl 3-hydroxybenzoate</b>	73.8, bz	295-282							35	58, al	
107	<b>1,3-Dibromo-2-naphthol</b>	75								102		
108	<b>2,5-Dimethylphenol</b> ( <i>p</i> -2-Xylenol)	75, al-eth	212	160 l, bz., 162, 166	172.3 lgr	87	137.2 (cor)	<i>tri</i> 178			61	Aryloxyacetic acid, 118 <i>p</i> -Xenylurethane, 162, <i>p</i> -Phenylazobenzoate, 95.5-7.5, Picrate, 81-2, or, al
109	<b>2,3-Dimethylphenol</b> ( <i>o</i> -3-Xylenol)	75, w-al		193.5								Aryloxyacetic acid, 187, <i>p</i> -Phenylazobenzoate, 134.6, Me eth., 29, b p 199, Et eth., 10, b p 212.5
110	<b>8-Hydroxyquinoline</b> (Oxine)	75.6, dil al	266.6 <sup>752</sup>			174.5			115	b p 280	118.20, al	Picrate, 203.4, Methiodide, 143 d (hyd)
111	<b>4-(Dimethylamino)phenol</b>	76							130	78		
112	<b>3-Chloro-4-hydroxybiphenyl</b>	76.7, 80									110.11, 95.7	2,4-Dinitrophenyl ether, 109-11
113	<b>3-Bromo-2,6-dichlorophenol</b>	76.5, lgr	264-70 <sup>751</sup>								102	Me eth., b p 260.5 <sup>50</sup>
114	<b>2-Methyl-4,5,6-trichlorophenol</b> (4,5,6-Trichloro- <i>o</i> -cresol)	77, pet eth								45, w-me al		Me eth. 51.5, al
115	<b>2-Bromo-4-methyl-3-nitrophenol</b> (2-Bromo-3-nitro- <i>p</i> -cresol)	77, yel., w								81		Me eth., 74
116	<b>3-(Diethylamino)phenol</b>	78	276-80								22.3	Methylurethane, 85.6, Methiodide, 140.3
117	<b>3-Phenylphenol</b> (3-Hydroxybiphenyl)	78, 75	>300						52.5		60.1, al	Et eth., 34
118	<b>4-Bromo-2,6-dinitrophenol</b>	78, yel							136, al	110.5, bz	154, al	Me eth., 88, Et eth., 66
119	<b>4-Chloro-2-iodophenol</b>	78		128						57	88, 84	
120	<b>2,4-Diaminophenol</b> (4-Hydroxy- <i>m</i> -phenylenediamine)	78-80 unstable										Me eth., 68, Et eth., 67.8, 4, N-Acetyl, 249, N,N'-Diacetyl, 220-2, O,N,N'-Triacetyl, 180.2, N,N'-Dibenzoyl, 253-4, Picrate, 120 d, yel
121	<b>4-Methyl-3-nitrophenol</b> (3-Nitro- <i>p</i> -cresol)	79, yel., eth							91			Me eth., 17, b p 266.7
122	<b>2,3,4,6-Tetramethylphenol</b> (Ivoduretol)	79-81	230-50	178.9, wh., w-al							71-2, wh., w-al	
123	<b>2-Bromo-4,5-dimethylphenol</b>	80, pet eth									51	Me eth., b p 86 <sup>2</sup> , <i>o</i> -Nitrobenzoate, 151-2

\*Derivative data given in order: m.p., crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point °C	Phenyl urethane	$\alpha$ Naphthyl urethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> Toluene sulfonate	Acetate	Benzoate	Miscellaneous
124	5-Bromo-2-methylphenol (5-Bromo- <i>o</i> -cresol)	80									41	
125	4-Iodo-2-nitrophenol	80 1									102 3	Me eth, 98, Et eth, 80
126	4-Hydroxy-3-methoxybenzaldehyde (Vanillin)	81	285	116 7					115	102	78	Aryloxyacetic acid, 187 2,4-Dinitrophenyl ether, 131, 2,4-Dinitrophenylhydrazone, 271 d
127	3,5-Dibromophenol	81								53	77	Me eth, 140
128	4-Chloro-2,6-dinitrophenol	81								110 11		Me eth, 66 Et eth, 54 5
129	4-Methyl-2-naphthol	81 2								117 8		
130	5-Chloro-2,3-dimethylphenol	81 2									88, al	
131	3-Methyl-2,4,6-tribromophenol (2,4,6-Tribromo- <i>m</i> -cresol)	81 5-2 0, al							113 4, al	68, al	84 5 al	<i>p</i> -Phenylazobenzoate, 130-2
132	2-Hydroxy-1-naphthaldehyde	82	192 <sup>2</sup>							87, al <i>tri</i> 124, al		Me eth, 84 Et eth, 115, Oxime 157, Picrate, 120
133	3,4-Di-iodophenol	83									123	
134	2-Hydroxvazobenzene (2-Benzeneazophenol)	83								-20	93 pet eth	Me eth, 41, Et eth, 44 Cu deriv, 225 6, al
135	5-Propylresorcinol (1,3-Dihydroxy-5-propylbenzene, Divarinol)	83 4, bz, (anh), 51, w								<i>di</i> 12-5		Di-Me eth, b p 147 <sup>29</sup>
136	2,3,4-Trichlorophenol	83 5, lgr									141, al	Me eth, 69 5, al
137	4-Benzylphenol (4-Hydroxydiphenylmethane)	84	321, 308								<i>mono</i> 87, pet	2,4-Dinitrophenyl ether, 75 6, Benzyl eth, 49 5, al
138	4-Chloro-2,3-dimethylphenol	84									102	
139	2,4-Dimethyl-1-naphthol	84 5	169 70 <sup>10</sup>	174 5								Me eth, b p 150-1 <sup>12</sup> , Picrate 143 4, dk red
140	4-Methyl-1-naphthol	84 5									81	
141	1-Bromo-2-naphthol	85							56			Me eth, 85
142	3-Bromo-2-naphthol	85							94			Me eth, 77-8
143	2-Nitroresorcinol (1,3-Dihydroxy-2-nitrobenzene)	85, or -red, w-al							<i>di</i> 63			Di-Me eth, 131, yel, al Di-Et eth, 106 7
144	3-(Dimethylamino)phenol (3-Hydroxydimethyl aniline)	85	265-8, 138 <sup>10</sup>							36 5, b p 160 <sup>3</sup>	94	Picrate, 162, Methylurethane, 87, Ethylurethane, 150, 99 100, Me eth, b p 237, Et eth, b p 247
145	3-Hydroxy-2-nitrobiphenyl	85-6, bz, 81 2, yel, al								61 5 2 5	131 0 2 5	Benzenesulfonate, 130-1, 4-Nitro deriv, 126 7, 6-Nitro deriv, 214, 4,6-Dinitro deriv, 168 70
146	2-Hydroxybenzyl alcohol (Saligenin)	86 7, w									<i>di</i> 51, 70% al	Aryloxyacetic acid, 120, w

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthylurethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
147	4,6-Dinitro-2-methylphenol (4,6-Dinitro- <i>o</i> -cresol)	86.5								95-6	135, 132	
148	3-Nitrocatechol (1,2-Dihydroxy-3-nitrobenzene)	86.5, yel, pet eth								<i>di</i> b p 103-4 <sup>1</sup>	2- <i>mono</i> 66	1-Me eth, 62, yel, 2-Me eth, 102-3, Di-Me eth, 64-5, al
149	4-Chloro-2-nitrophenol	86-7								47.8		Me eth, 98 Et eth, 61-2
150	2,4,5-Tribromophenol	87, CH <sub>2</sub> Cl <sub>2</sub> -pet eth									99	Me eth, 105, <i>o</i> -Br- <i>p</i> -toluenesulfonate, 107.8, al
151	4-Bromocatechol (4-Bromo-1,2-dihydroxybenzene)	87									<i>di</i> 111	1-Me eth, 65
152	4-(Methylamino)phenol	87, bz							135, bz - lgr	43, pet eth	173-4, 50% al	Aryloxyacetic acid, 213.4, Me eth, 37
153	2-Methyl-3,4,5-tribromophenol (3,4,5-Tribromo- <i>o</i> -cresol)	89, pet										
154	2-Amino-6-methylphenol (6-Amino- <i>o</i> -cresol)	89, w							89, 90	78-9		N-Acetyl, 100.1
155	<i>N</i> -Benzylidene-2-aminophenol	89								93-6		Et eth, b p 215-6 <sup>20</sup>
156	3-Nitro-2,4,6-tribromophenol	89-90, lgr							146-7, al			Me eth, 82, al, Et eth, 79, eth N,O-Diacetyl, 162.3
157	2-Amino-6-chloro-4-methylphenol (2-Amino-6-chloro- <i>p</i> -cresol)	89-90										
158	1,3-Dimethyl-2-naphthol	89-90		197					85.6			Picrate, 132-3
159	2-Propylhydroquinone (1,4-Dihydroxy-2-propylbenzene)	90, bz										Di-Me eth, b p 240-6
160	4-Chlorocatechol (4-Chloro-1,2-dihydroxybenzene)	90-1	136 <sup>8,5</sup>							<i>di</i> b p 145-7 <sup>7</sup>	<i>di</i> 96-7, eth	Di-Me eth, b p 242.4
161	3-Chloro-4,6-dimethylphenol	90-1										
162	2-Methyl-3,4,6-tribromophenol (3,4,6-Tribromo- <i>o</i> -cresol)	91, pet								76-7, ac a	85, 133, bz	Me eth, 71, al
163	5-Chloro-2,4-dinitrophenol	92								69		Me eth, 105, Et eth, 112, 6-Nitro deriv, 113.5
164	4-Chloro-2,6-dibromophenol	92							107-8			2,4-Dinitrophenyl ether, 145-6 Me eth, 74
165	4-Bromo-2-nitrophenol	92, 89								75		Me eth, 88 Et eth, 47, Benzenesulfonate, 83-4
166	4- <i>tert</i> -Amylphenol	92-3	260-5	108					55		61	
167	4-Hydroxyphenylethyl alcohol (Tyrosol)	93, chl	310, 156 <sup>15</sup>							$\beta$ - <i>mono</i> 59, eth - lgr <i>di</i> b p 187 <sup>18</sup>	<i>di</i> 111, al	4-Et eth, 40

\*Derivative data given in order: m.p., crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthylurethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
168	4-Iodophenol	93 4, w		148, bz					99, me al	32	119	Aryloxyacetic acid 156, N,N-Di-phenylurethane 127, 2,4-Dinitrophenyl ether, 156
169	1-Naphthol ( $\alpha$ -Naphthol)	94	278-80	177-8, al	152, lgr	143, 140	217 4 (cor), yel, al	2,4-di 105	89	48-9, al	56, al	Aryloxyacetic acid, 193 5, <i>p</i> -Xenylurethane, 190 2,4-Dinitrophenyl ether, 128, <i>p</i> -Phenylazo-benzoate, 118-9
170	2-Iodo-4-nitrophenol	94, 86-7								68		Me eth, 97, Et eth, 96
171	2,4,6-Tribromophenol (Bromol)	95, HCOOH 94, ac a (+1 ac a)			153	153	174	tetra 120	113, al	82, 87 ac a	81, al	Aryloxyacetic acid, 200, N,N-Di-phenylurethane, 153, 2,4-Dinitrophenyl ether, 137 8 <i>p</i> -Phenylazo-benzoate, 116-9
172	2,2'-Stilbenediol (2,2'-Dihydroxystilbene)	$\alpha$ 95, al, $\beta$ 197, al									$\alpha$ di 107-8	$\beta$ Di-Me eth 136
173	6-Chloro-1-naphthol	95								47		Picrate, 165
174	3-Bromo-4-hydroxybiphenyl	95								74 5	93 4	Benzenesulfonate 102 3
175	1,3,6-Trihydroxynaphthalene (1,3,6-Naphthalenetriol)	95								tri 112-3		Me eth, 103-4
176	2,3,4-Tribromophenol	95, w - HCOOH										Me eth, 106
177	2,3,5-Trimethylphenol	95 6	233	174, pet eth						241	50, pet eth	
178	2-Naphthyl salicylate (Betol)	95 5, stable, 93 5, labile		268, yel, ac a						136, al		
179	3-Amino-2,4,6-trichlorophenol	95 5-6 0, lgr										N-Acetyl, 185 0 6 5, tol
180	3-Acetylphenol (3-Hydroxyacetophenone)	96	296, 153 <sup>3</sup>							44 0-4 5	52-3	D <sup>100</sup> 1 099, n <sub>D</sub> <sup>20</sup> 1 5348 Me eth b p 240, Semi-carbazone, 194-6
181	5-Iodo-2-nitrophenol	96, yel, pet eth								95	122	Me eth, 92, Et eth, 86-7
182	2-Methoxy-5-propenylphenol	96, 92	147 <sup>19</sup>							101		Et eth, 49 50
183	2-Methyl-4-nitrophenol (4-Nitro- <i>o</i> -cresol)	96, yel, bz, 30-40 (+1 H <sub>2</sub> O), w	186 90							107, al	128	Me eth, 64, al, Et eth, 71, w -al
184	2-(Methylamino)phenol	96-7, 86 7, pet eth									157 9	N-Benzoyl, 160 1, Me eth, 33 0-3 5
185	3-Nitrophenol	97	194 <sup>70</sup>	129	167	174	159	di 91	112 3	55-6	95	D <sup>100</sup> 1 2797, Aryloxybenzoic acid, 156, 2,4-Dinitrophenyl ether 136, <i>p</i> -Phenylazo-benzoate, 160 5-2 5

\* Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point °C	Phenylurethane	$\alpha$ -Naphthylurethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>l</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous	
186	2,3-Dibromo-5,6-dimethylphenol	97, aq al								78, pet eth	153, al		
187	5-Methyl-1-naphthol	97-8									77-8		
188	3-Acetylcatechol (2,3-Dihydroxyacetophenone)	97-8, yel, w								di 109, bz		1-Me eth, 152-3 Di-Me eth, 48, Oxime 96-7 Semicarbazone, 166-7	
189	2-Cyanophenol	98									106, pet eth	D <sub>4</sub> <sup>99</sup> 6, 1 1052 n <sub>α</sub> <sup>99</sup> 6 1 53716	
190	3-Chloro-4,5-dimethylphenol	98									42, al		
191	2,5-Di-iodophenol	99, pet eth								70, ac a			
192	4- <i>tert</i> -Butylphenol	100	237	148-5	110			50 di 64-7	109-10		81-2	Aryloxyacetic acid, 86-5, 2,4-Dinitrophenyl ether 108-10 Benzene-sulfonate 70-1	
193	3,4,5-Trichlorophenol	101, lgr, 91	271 77 <sup>46</sup>								120, al	Me eth, 130, b p 256-61, <i>m</i> -Nitrobenzenesulfonate, 176	
194	3,5-Dibromo-2-methylphenol (3,5-Dibromo- <i>o</i> -cresol)	101-98-101									91-3		
195	4,6-Dinitro-3-methylphenol (4,6-Dinitro- <i>m</i> -cresol)	101-73-4							110-11		95	Me eth, 115- Et eth, 97	
196	2-Acetyl-1-naphthol	102, pa grn, al, 98, br-yel, bz	325, sl d							107-5, al	128, al		
197	2-Methyl-3,4,5-trinitrophenol (3,4,5-Trinitro- <i>o</i> -cresol)	102, or yel, acet										Me eth, 111-2, w-al	
198	4-Methyl-2,3,6-tribromophenol (2,3,6-Tribromo- <i>p</i> -cresol)	102, pet								77, lgr			
199	1-Nitro-2-naphthol	103, yel, al								61, pet eth		<i>m</i> -Nitrobenzenesulfonate, 176, ac a, Et eth, 104-5, yel, al	
200	3,3'-Dihydroxydiphenylmethane	103, yel, al								di 57-58-5, lgr			
201	4-Chloro-2-naphthol	104								56			
202	3,5-Di-iodophenol	104, w								79, me al	93	Me eth, 85, pet eth, Et eth, 30, me al	
203	2-Bromo-4-methyl-5-nitrophenol (2-Bromo-5-nitro- <i>p</i> -cresol)	104, yel								121		Me eth, 94, yel, eth	
204	3-Hydroxybenzaldehyde (3-Formylphenol)	104, 108 (cor)	240	158-60							b p 203	38, 48-5-90	Aryloxyacetic acid, 148, 2,4-Dinitrophenylhydrazone, 257-d, Semicarbazone, 198
205	5-Methyl-2-naphthol	104-5									107-8	Picrate, 156-7	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthyl urethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
206	3-Hydroxy-4-nitrobiphenyl	104 5, al				157	199					
207	Catechol (Pyrocatechol, 1,2-Dihydroxybenzene)	105	245 6	<i>di</i> 169	175	<i>mono</i> 159 <i>di</i> 169, al	<i>di</i> 152	<i>tetra</i> 192 3, wh - vlt	<i>mono</i> 57 8, <i>di</i> 65		<i>mono</i> 181, 131 <i>di</i> 84, al - eth	Aryloxyacetic acid 136 8 Monobenzenesulfonate monoacetate, 86 me al Dibenzene-sulfonate, 155-6, acet Me eth, 54-5, al <i>sym</i> -TNB add comp, 97, Picrate, 97, yel
208	2,4-Dibromo-1-naphthol	105, 111								92-3		<i>m</i> -Nitrobenzoate, 154, <i>o</i> -Nitro- <i>p</i> -toluenesulfonate, 143
209	2,4-Dichloro-5-nitrophenol	105 6									111 2	
210	Chlorohydroquinone	106								<i>mono</i> 62, <i>di</i> 72, 99 113 125		
211	4,6-Dinitro-2-iodophenol	106 7, w							149			
212	1,6-Dibromo-2-naphthol	106-7 (+1 ac a, 84)										Me eth, 102, Et eth, 94
213	2-Amino-5-chloro-4-methylphenol (2-Amino-5-chloro- <i>p</i> -cresol)	106-7										N-Acetyl, 115, aq al, Me eth, 106, lgr
214	4-Chlororesorcinol (4-Chloro-1,3-dihydroxybenzene)	106-7 89	259, 147 <sup>18</sup>						<i>di</i> 46 7	<i>di</i> 66		3-Me eth, 79-80 Di-Me eth, b p 135 7 <sup>17</sup>
215	2-Hydroxypyridine ( $\alpha$ -Pyridone)	106 7, bz	280 1			120			158-9, 53	b p 150-60 <sup>9</sup> 99	42	Picrate, 176 7, Benzyleth, 42
216	2-Phenoxyphenol (2-Hydroxydiphenyl ether)	106 7	151 5 <sup>11</sup>							b p 358-60	48 5	Me eth, 79, lgr
217	5-Methylresorcinol (Orcinol, 3,5-Dihydroxytoluene)	106 5 8, 56 8 (+1 H <sub>2</sub> O)	287-90	154	160, lgr	214	190	<i>tri</i> 104		<i>di</i> 25	<i>di</i> 88, al	Aryloxyacetic acid 217 <i>p</i> -Xenylurethane, 196 2,4-Dinitrophenyl ether, 153 4
218	6-Amino-4-chloro-2-methylphenol (6-Amino-4-chloro- <i>o</i> -cresol)	107								2,3- <i>di</i> 196		
219	2,4-Dichloro-1-naphthol	107-8								74-6		Me eth, 58
220	1,2-Dihydroxynaphthalene (1,2-Naphthalenediol, $\beta$ -Naphthohydroquinone)	108, 105 5								<i>di</i> 104-6, 109, ac a	<i>di</i> 106	Diaryloxyacetic acid, 104 6, 1-Me eth, 90 5, Di-Me eth, 31
221	1,2,3,4-Tetrahydroanthranol	108, lgr								109, al	142	Me eth, b p 197 <sup>14</sup>
222	4-Methyl-5,6,7,8-tetrahydro-2-naphthol	108				114 6					89	
223	4-Acetylphenol (4-Hydroxyacetophenone)	109								54		Semicarbazone, 199, 2,4-Dinitrophenylhydrazon 261 5 (cor), br, al
224	3-Methyl-2,4,6-trinitrophenol (2,4,6-Trinitro- <i>m</i> -cresol)	109 10, yel, al								135, pa yel, bz	140	Di-Me eth, 155, al, Di-Et eth, 36 7, w - al

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	$\alpha$ -Naphthylurethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
225	<b>2-Iodo-6-nitrophenol</b>	109-10								96-7		Me eth, 96-7
226	<b>Resorcinol (1,3-Dihydroxybenzene)</b>	110 (stable), 108.85 (labile)	280.8 (cor), 275.9	<i>di</i> 164, chl		<i>di</i> 182, 175	<i>di</i> 201	<i>tri</i> 112	<i>di</i> 80-1, acet-dil al	57-8, dil al	<i>mono</i> 135-6, <i>di</i> 117, dil al	Aryloxyacetic acid, 175, 195, 2,4-Dinitrophenyl ether, 194, N,N-Diphenylurethane, 194, Me eth, 43-4, me al
227	<b>2,2-Biphenol (2,2-Dihydroxybiphenyl)</b>	110-109, tol	326	<i>di</i> 145, dil al				<i>di</i> 188	190	<i>di</i> 95, xyl	<i>di</i> 101, al	Di-Me eth, 155, al, Di-Et eth, 36-7, w-al
228	<b>Bromohydroquinone</b>	110						<i>di</i> 186		<i>di</i> 72		
229	<b>4-Hydroxy-2'-nitro-biphenyl</b>	110, 1, 116								122	156-7	Aryloxyacetic acid, 160-1, Benzene-sulfonate, 106, yel, al, Me eth, 60.0-0.5, Et eth, 51.5-nitro deriv, 151-2
230	<b>7-Methyl-1-naphthol</b>	110-11								39-41		Picrate, 164-5
231	<b>1-Methyl-2-naphthol</b>	111								66	116.7	Picrate, 163.4
232	<b>2-Chloro-4-nitrophenol</b>	111, w								63		Me eth, 98, Et eth, 82, 142
233	<b>2-Amino-6-nitrophenol</b>	111-2 aq al								2- <i>mono</i> 102-3 (hyd), 122 (anh)		Me eth, 198
234	<b>2,4,6-Tribromoresorcinol (1,3-Dihydroxy-2,4,6-tribromobenzene)</b>	112, w								<i>mono</i> 114, CS <sub>2</sub> , <i>di</i> 108	<i>mono</i> 120, chl-pet-eth	Me eth, 104, Di-Me eth, 68-9, w-al
235	<b>4',5-Dimethyl-2-hydroxyazobenzene (2-<i>p</i>-Toluene-azo-<i>p</i>-cresol)</b>	112.3, tol								91, yel, ac a	95, yel, al	Et eth, 43, ac a, Propionate, 62, lgr
236	<b>4-Hydroxyphenanthrene (4-Phenanthrol)</b>	112-3.5, pet eth								58-9, al		Me eth, 68, me al
237	<b>2,2'-Dihydroxy-3,3'-dimethylbiphenyl</b>	113, pet eth									<i>di</i> 147, me al	
238	<b>2,6-Dinitro-4-iodophenol</b>	113, w							138		175	
239	<b>2-Chloro-4,6-dinitrophenol</b>	113, 110							155			
240	<b>4,4'-Dihydroxy-2,2'-dimethylbiphenyl</b>	114								<i>di</i> 75	<i>di</i> 127	
241	<b>2-Bromo-4-nitrophenol</b>	114								62, 86	131-2	Me eth, 106, Et eth, 98, yel
242	<b>4-Nitrophenol</b>	114		156	150-1	159	186, 188 (+1 ac a)	2,6- <i>di</i> 142	97	81-2, w-al	142.5	Aryloxyacetic acid, 187, 2,4-Dinitrophenyl ether, 120, N,N-Diphenylurethane, 112, <i>p</i> -Phenylazobenzoate, 203-6
243	<b>2,4-Dinitrophenol</b>	114				139		6- <i>mono</i> 118	121	72	132	2,4-Dinitrophenyl ether, 248
244	<b>2,3,5-Tri-iodophenol</b>	114, bz-lgr								123		Et eth, 121

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthylurethane	<i>p</i> -Nitrobenzoate	3,5-Di nitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
245	4-Hydroxy-3-methoxybenzyl alcohol	115								4-mono 51, di 48, bz lgr 130-1, aq al	4-mono 90, et ac-al, di 121 128-9	4-Et eth, 56 7
246	1-Hydroxyfluorenone	115, yel										Me eth, 141 5 2 5 Oxime, 169-70, Phenylhydrazone, 173-4
247	Ethyl 4-hydroxybenzoate	115, 116	297-8								94, eth	
248	4-Chloro-3,5-dimethylphenol	115-6								47 8		
249	3,5-Dimethyl-2,4-dinitrophenol	115-6, 106							171	148	156	
250	4-Bromo-1,5-dihydroxynaphthalene (4-Bromo-1,5-naphthalenediol)	116								di 138		Di-Me eth, 115
251	3-Benzoylphenol (3-Hy)	116 al										Oxime <i>anti</i> 76 bz <i>syn</i> 126 (on heating <i>anti</i> )
252	4-Hydroxybenzaldehyde	116-7									90	Aryloxyacetic acid 198, 2,4-Dinitrophenylhydrazone 270 1 Naphthalene add comp, 100
253	3-Bromo-1,2-dihydroxynaphthalene (3-Bromo-1,2-naphthalenediol)	117								di 160		Naphthalene add comp, 100
255	Phloroglucinol (1,3,5-Trihydroxybenzene)	117 (+2H <sub>2</sub> O), 217-9 (anh)				283		tri 151		tri 104	tri 185	Picrate, 101-3
256	2,4'-Dihydroxydiphenylmethane	117-8, w-al								di 70, ac a	di 108	Di-Me eth, 26 Di-Et eth, 60, w-al
257	2,3,5,6-Tetramethylphenol (Durenol)	118, wh, pet	249					4-mono 118, or, dil al				
258	4-Amino-2-methyl-6-nitrophenol (4-Amino-6-nitro- <i>o</i> -cresol)	118, al								4-mono 217, yel, al		
259	2,4-Dibromo-6-nitrophenol	118, ac a							140	89		Me eth, 76-7, yel, Et eth, 46
260	2-Methyl-5-nitrophenol (5-Nitro- <i>o</i> -cresol)	118, yel, lgr							123-4, al	74		Me eth, 74, al, Et eth, 61, al
261	2-Bromo-4,6-dinitrophenol	118-9, yel							157	104 5	94, aq al	Me eth, 48, yel
262	2-Bromo-5-nitrophenol	118 5-21, pet eth							131 5-2 5, al			Me eth, 104, al
263	2-Amino-4-methyl-6-nitrophenol (2-Amino-6-nitro- <i>p</i> -cresol)	119, 110, br, al										N-Acetyl, 143, yel al
264	3-Amino-2,4,6-tribromophenol	119, pet eth								146-7, al		O,N,N-Triacetyl, 136

\*Derivative data given in order m p, crystal color, solvent from which crystallized



TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthylurethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
265	2-Methylresorcinol (1,3-Dihydroxy-2-methylbenzene, 2,6-Dihydroxytoluene)	119 20, bz	271 (cor)								<i>di</i> 105-6, me al	Di-Me eth, 39
266	4-Acetylcatechol (3,4-Dihydroxyacetophenone)	119 2 7 116							<i>di</i> 144-5, et ac	4-mono 58, <i>di</i> 91, 88	<i>di</i> 118, al	Oxime, 184 d, et ac, 1-Me eth, 91, 2-Me eth, 115, Di-Me eth, 51
267	2-Chloro-5-nitrophenol	119 5, w								82	127-8	Me eth, 83, Et eth, 64 5, al
268	5-Methyl-1,2,3-trihydroxybenzene (3,4,5-Trihydroxytoluene, 5-Methylpyrogallol)	120 (subl), bz								<i>tri</i> 99		3,5-Di-Me eth, 36, al
269	9-Hydroxyanthracene (9-Anthrol, Anthranol)	120, yel								126 31	286 8	
270	6-Bromo-2-methyl-4-nitrophenol (6-Bromo-4-nitro- <i>o</i> -cresol)	120 d, yel, lgr								137		
271	2,2'-Dihydroxy-4,4'-dimethylbiphenyl	120									<i>di</i> 148, al - acet	
272	4-Nitro-2-naphthol	120, yel, pet eth							122, pa yel, al			<i>m</i> -Nitrobenzenesulfonate, 149, ac a, Me eth, 100-3, br, bz-al
273	4-Chloro-1-naphthol	120 1, 116 7, al or chl								44		Picrate, 171, Carbonate, 228
274	2-Chloro-3-nitrophenol	120 5, w								51 5	94	Me eth, 94, Et eth, 51, me al
275	4-Chloro-3,5-dibromophenol	121									132	Me eth, 82 5
276	3,4-Dimethyl-1-naphthol	121 5 3 0, lgr	205 10 <sup>15</sup>				222 4			89 5 91		Turns red in air, Picrate, 168
277	3-Aminophenol (3-Hydroxyaniline)	122				143	179					N-Acetyl, 148, N- <i>p</i> -Toluenesulfonyl, 157, N-Phenylthiourea, 156
278	2-Amino-3-chlorophenol	122										N-Acetyl, 123, N-Benzoyl, 123, HNO <sub>3</sub> salt, 137
279	4-Bromo-2-naphthol	122								61		Me eth, 64
280	4-Nitroresorcinol (1,3-Dihydroxy-4-nitrobenzene)	122, yel, CCl <sub>4</sub>	178-9 <sup>11</sup>							<i>di</i> 90-1, al	1-mono 124, ac a, 3-mono 189, ac a, <i>di</i> 110	Di-Et eth, 85
281	2,4,6-Trinitrophenol (Picric acid)	122 (subl on slow htng, exp on rapid htng)								76		Naphthalene add comp, 149-51

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	$\alpha$ -Naphthyl urethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> Toluene sulfonate	Acetate	Benzoate	Miscellaneous
282	3-Hydroxyphenanthrene (3-Phenanthrol)	122 3, al								114 5, aq al		Me eth, 63, me al, Et eth, 46, me al, Picrate, 124-5, red, al
283	2,4-Dichloro-6-nitrophenol	122 3								77		3-Nitrobenzoate, 149-50
284	2-Naphthol ( $\beta$ -Naphthol)	123	286	155-6, al	156 7, lgr	169	210 2 (cor), al	84	125, al	71 2 70	106-7	Aryloxyacetic acid, 95, 2,4-Dinitrophenyl ether, 95, N,N-Diphenylurethane, 141, <i>p</i> -Phenylazobenzoate, 190 3
285	2,3,4,5-Tetrabromophenol	123, aq al						225 6		110 5, aq ac a	133, al	
286	2,4-Dimethyl-2-methoxyphenol	123							137 8	114		Et eth, 91
287	2-Nitro-4,5,6-tribromophenol	123, yel, bz										Me eth, 109, al, Et eth, 74
288	1,4-Dichloro-2-naphthol	123 4								90 1		
289	4-Butyl-2-methylphenol (4-Butyl- <i>o</i> -cresol)	124	127 9 <sup>15</sup>							268 70		
290	3,3'-Biphenol (3,3'-Dihydroxybiphenyl)	124, w								<i>di</i> 82 5, <i>dil</i> al	<i>di</i> 92	Di-Me eth, 36, w-al, b p 328
291	1,3-Dihydroxynaphthalene (1,3-Naphthalenediol)	124, w								<i>di</i> 56, w-ac a		<i>sym</i> -Trinitrobenzene add comp, 174 5, red
292	3-Iodo-4-nitrophenol	124, yel, pet eth								73 7	119	Me eth, 69-70
293	2-Methylhydroquinone (2,5-Dihydroxytoluene)	124 5, bz						84	125	<i>mono</i> 92, pet eth, <i>di</i> 49, 45, w	<i>di</i> 119-20	Aryloxyacetic acid, 153, Di-Et eth, 24 5, b p 247-9
294	4-Hydroxybenzyl alcohol ( $\alpha$ ,4-Dihydroxytoluene)	124 5 5 5								$\alpha$ - <i>mono</i> 84, <i>di</i> 75	$\alpha$ - <i>mono</i> 88 9	
295	4,6-Dimethylresorcinol (4,6-Dihydroxy- <i>m</i> -xylene)	124 5-5 0, w (+1 w)	276 9							<i>di</i> 45, al, b p 285-7		Di-Me eth, 76, Di-Et eth, 75, al
296	4-Benzyl-1-naphthol	125-6								87-8	103	
297	Pentamethylphenol	126	267	215						273	127	Me eth, 163 4
298	3,5-Dinitrophenol	126, 122								126 7		Me eth, 105-6, Et eth, 97
299	7-Chloro-2-naphthol	126 5								104 5		
300	4-Chloro-3-nitrophenol	126 5 w								83 5	96-7	Me eth, 98, al, Et eth, 47 5, al
301	2-Nitro-3,4,6-tribromophenol	127, pa yel, w-HCOOH								118		Me eth, 72, w-HCOOH
302	2-Nitro-1-naphthol	127-8, yel, al								118		Me eth, 80, Et eth, 84, yel, lgr
303	1,3-Dibromo-2,4-dihydroxynaphthalene (1,3-Dibromo-2,4-naphthalenediol)	128 9, ac a						186, CS <sub>2</sub>		4- <i>mono</i> 148, <i>di</i> 125, al		

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	$\alpha$ Naphthyl urethane	<i>p</i> Nitro benzoate	3,5-Di nitro benzoate	Bromo derivative	<i>p</i> Toluene sulfonate	Acetate	Benzoate	Miscellaneous
304	4-Iodo-2-naphthol	128.5								59		Me eth, 67
305	4-Bromo-1-naphthol	129								51		
306	3-Methyl-4-nitrophenol (4-Nitro- <i>m</i> -cresol)	129, w								34, al	74	Me eth, 55, lgr, Et eth, 45, al
307	3-Hydroxypyridine ( $\beta$ -Pyridone)	129								b p 210, 92°	50-0.5	Hydrochloride, 105-7, Picrate, 200-1
308	4-Hydroxy-3-nitroazobenzene	129, lgr								120.5, ac a	132, bz	Me eth, 107
309	3-Amino-2-methylphenol (3-Amino- <i>o</i> -cresol)	129, w								108		Turns br in air
310	6-Bromo-2-naphthol	129.30								103		Me eth, 108
311	8-Nitro-1-naphthol	130										<i>m</i> -Nitrobenzenesulfonate, 166, ac a
312	4-Amino-2-nitrophenol	131, dk red										Me eth, 243, Et eth, 170, N-Acetyl, 157-8, yel
313	Methyl 4-hydroxybenzoate	131		134-5, bz						85	135	
314	5-Methyl-1,2,4-trihydroxybenzene (2,4,5-Trihydroxytoluene)	131.2, bz								<i>tri</i> 114.5, al		4-Me eth, 124, w, 4-Et eth, 131 (subl), bz, Tri-me eth, 55, w-me al
315	5-Chloro-1-naphthol	131.2, w or CS <sub>2</sub>								53		Picrate, 160
316	4-Cyclohexylphenol	132		145.5		137, al	168 (cor)			35	118.5, me al	
317	Pyrogallol (1,2,3-Trihydroxybenzene)	133	309	<i>tri</i> 173		<i>tri</i> 230	<i>tri</i> 205	<i>di</i> 158		<i>di</i> 110-11, <i>tri</i> 165, 173	<i>mono</i> 140, <i>di</i> 108, <i>tri</i> 90, al	Tris-N,N-Diphenylurethane, 212
318	2-Amino-4,6-dimethylphenol	134-5, al										N-Acetyl, 96, aq al, O,N-Dibenzoyl, 153.5 Me eth, b p 239-40
319	4-Amino-5-isopropyl-2-methyl-6-nitrophenol (4-Amino-5-isopropyl-6-nitro- <i>o</i> -cresol)	134.5 yel, al									1-mono 280-3, <i>di</i> 222.5, bz	
320	4,6-Dibromo-2-naphthol	134-5								128	128.9	Me eth, 103, Et eth, 98
321	2,3-Dichloro-1,4-dihydroxynaphthalene	135, 155-6, aq al								<i>di</i> 239-40	<i>di</i> 252	Di-Me eth, 107-8, Dipropionate, 166-7, Dibutyrate, 128
322	4-Benzoylphenol (4-Hydroxybenzophenone)	135								81, me al	115, 94-5	2,4-Dinitrophenylhydrazone, 242.4 (cor), Semicarbazone, 194

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	$\alpha$ Naphthyl urethane	<i>p</i> -Nitro benzoate	3,5 Di nitro benzoate	Bromo derivative	<i>p</i> Toluene sul fonate	Acetate	Benzoate	Miscellaneous
323	2-Amino-4-methylphenol (2-Amino <i>p</i> -cresol)	135, w										N-Benzoyl, 191, al, O,N-Dibenzoyl, 190-1, al, O,N-Diacetyl, 128-9, Me eth, 93-4, pet eth
324	3-Amino-4,6-dichlorophenol	135-6 w							113-4			N-Acetyl, 233-6, Me eth, 51
325	2,6-Dinitrohydroquinone	135 6 (anh)								4-mono 95-6, di 135-6 77-8	4-mono 150 1	4-Me eth, 102, Di-Me eth, 95-6 112
326	1,4-Dimethyl-2-naphthol	135 6										
327	Trichlorohydroquinone	136, w								di 153 (subl)	124-5	Di-Et eth, 68 5, al
328	5-Iodo-3-nitrophenol	136, w								110	100 5	Me eth, 84
329	Trichlorophloroglucinol	136, al								tri 167 8, ac a		Di-Me eth, 93-5 Tri-Me eth, 130-1, al
330	1,6-Dihydroxynaphthalene (1,6-Naphthalenediol)	137-8, bz								di 73, al	di 103-4	Di-Me eth, 60-1 pet eth, Di-Et eth, 83, lgr, 2-Naphthylamine add comp, 110 5
331	2,4-Dinitro-1-naphthol	138									174	Me eth, 97, Et eth, 92
332	4-Amino-2,6-dimethylphenol	138 d, bz										N-Acetyl, 136-7, aq al, O,N-Diacetyl, 160, Me eth, 66, w
333	2-Amino-3-bromophenol	138							120-1, al			Me eth, 65, Hydrochloride, 225
334	2-Amino-4-chlorophenol	138 (unstable)							115	73-4		N-Acetyl, 185, O,N-Dibenzoyl, 157-8, Me eth, 82-3
335	1,4,6-Trihydroxynaphthalene (1,4,6-Naphthalenetriol)	138-40								94 5		
336	2,6-Dibromo-3,4,5-trihydroxybenzoic acid (Dibromogallic acid)	139 d (+1H <sub>2</sub> O)								tri 168	tri 95-6	Triacetate of Me eth, 150-2
337	2-Hydroxy-2'-nitro-biphenyl	139-40				116	180	3,5-di 149	100		116	3-Nitrobenzenesulfonate, 161, 4-Nitrobenzenesulfonate, 147, 2,4-Dinitrophenyl ether, 118, Me eth, 82, 3,5-Dinitro deriv, 123
338	4-Phenyl-1-naphthol	140									73-4	
339	1,3-Dihydroxy-2-methylnaphthalene (2-Methyl-1,3-naphthalenediol)	140								118		
340	1,2,4-Trihydroxybenzene	140-5, eth								tri 96-7, wh, abs al	tri 120, al	Tri-Et eth, 34, al, Picrate, 96
341	2-Amino-5-iodophenol	141										N- <i>p</i> -Toluenesulfonyl, 175-6

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthyl urethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
342	4-Hydroxy-2-nitro-biphenyl	141-3								169	105.6	Me eth, 72
343	1,8-Dihydroxynaphthalene (1,8-Naphthalenediol)	142, ac a, 140, w								<i>di</i> 155 ac anh	<i>di</i> 174.5	Di-Me eth, 50, pet eth Picrate, 135.7 2-Naphthylamine add comp, 124
344	2-Amino-4-nitrophenol	142.3 (anh), 80-90 (hyd)				122			122, yel, al			N-Acetyl, 279, N-Benzoyl, ca 200 d, Me eth 124.5 Et eth, 97.8
345	3,4-Dihydroxyphenanthrene (Morphol)	143, pet eth								<i>di</i> 159, eth		Me eth, 62.3, Di-Me eth, 45, me al
346	3-Chloro-1-naphthol	143, 134.5, lgr								69, lgr	118.9	Me eth, b p 162-4 <sup>18</sup>
347	2-Isopropyl-5-methylhydroquinone (Thymoquinol)	143, 139.5	290	232.3, al	147.8, al					<i>di</i> 73.5	141.2, al	
348	2,6-Dibromo-4-nitrophenol	144							128.9	181		
349	3,4,5-Tribromocatechol (+1H <sub>2</sub> O)	144								<i>di</i> 120		Di-Me eth, 86-7
350	3-Amino-4-methylphenol (3-Amino- <i>p</i> -cresol)	144										N-Acetyl, 178 O, N-Diacetyl, 128.9 N-Benzenesulfonyl, 183, Me eth, 47, w
351	8-Nitro-2-naphthol	144-5, yel								101-2, w-al		<i>m</i> -Nitrobenzenesulfonate, 144-6, ac a, Me eth, 69, Et eth, 72-3, yel, pet eth
352	4-Benzylresorcinol (2,4-Dihydroxybenzophenone)	144.6								<i>di</i> 78		
353	1-Hydroxyacenaphthene (1-Acenaphthenol)	144.5-5.5 (cor), 148		137						b p 166-8 <sup>5</sup>		
354	4-Amino-2,3,6-trinitrophenol	145 d, ac a										N-Acetyl, 178-9, N-Benzoyl, 205, ac a, Me eth, 138-9, al
355	4-Benzylcatechol (3,4-Dihydroxybenzophenone)	145, 134									<i>di</i> 95	Me eth, 131-2, Di-Me eth, 103.4
356	3-Bromo-5-nitrophenol	145								99		Me eth, 88
357	3,4-Dihydroxybiphenyl (4-Phenylcatechol)	145								<i>di</i> 77.5 80		
358	2,4,6-Tri-iodoresorcinol	145, CS <sub>2</sub>								<i>di</i> 170		
359	2,4'-Dihydroxychalcone	145								<i>di</i> 94.5	<i>di</i> 120	4'-Me eth, 148 d, al
360	2,6-Diamino-4-methylphenol (4-Hydroxy-3,5-toluenediamine)	146										N,N'-Diacetyl, 225-7, dil al, 1,2,6-Triacetyl, 128, al
361	5-Aminoresorcinol (3,5-Dihydroxyaniline)	146-52										N-Benzoyl, 139, Di-Me eth, 46, Picrate, 167-70 d, yel, aq al

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthylurethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> Toluene sulfonate	Acetate	Benzoate	Miscellaneous
362	4-Acetylresorcinol (Resacetophenone, 2,4-Dihydroxyacetophenone)	147								3-mono 119 20, 4-mono 74, di 38	3-mono 67, 4-mono 106 7	Semicarbazone, 216, 2,4-Dinitrophenylhydrazone, 218, Oxime, 199, Phenylhydrazone, 159
363	3-Chloro-5-nitrophenol	147								84	78	Me eth, 101, Et eth, 47, al
364	5-Nitro-2-naphthol	147, yel, w										<i>m</i> -Nitrobenzenesulfonate, 106, ac a, Et eth, 115, yel, al
365	2-Methyl-3-nitrophenol (3-Nitro- <i>o</i> -cresol)	147, yel, w							94, al			Me eth, 52 3, w-me al
366	2-Chloro-4-hydroxybenzaldehyde	147 8								52	97	Semicarbazone, 214, Oxime, 194, <i>p</i> -Nitrophenylhydrazone, 288 d
367	1,5-Dibromo-4,8-dihydroxynaphthalene	147 5								di 131		
368	5-Acetylresorcinol (3,5-Dihydroxyacetophenone)	148								di 91 2		Semicarbazone, 205 6 <i>p</i> -Nitrophenylhydrazone, 236 7
369	2,4-Dinitroresorcinol	148							mono 126-7	di 119 20	di 182 4	Aryloxyacetic acid, 155, Me eth, 108, Di-Et eth, 57
370	4-Propionylphenol (4-Hydroxypropiophenone)	148								62, lgr	107 5	2,4-Dinitrophenylhydrazone, 229
371	9,10-Dihydroxyphenanthrene (9,10-Phenanthrenediol)	148								mono 168 70, di 202	di 216 7	
372	3,4,5-Trihydroxyphenanthrene (3,4,5-Phenanthrenetriol)	148, w								tri 138, bz-pet eth		Tri-me eth, 90, me al
373	4-Hydroxypyridine ( $\gamma$ -Pyridone)	148 5 (anh), 65 (+1 H <sub>2</sub> O)	>350							140 50	81	Picrate, 240, Methiodide, 108 9
374	3-Nitrosalicylic acid	148 5-9 0										Amide, 155, 145
375	3-Acetamidophenol (3-Hydroxyacetanilide)	148 9, w								99 5 100 5		
376	2-Amino-3,6-dimethylphenol	149 50, bz										N-Benzoyl, 210-11, O,N-Dibenzoyl, 178-9
377	2,6-Dimethylhydroquinone	149-51, xyl										4-Me eth, 77, pet eth
378	2,4'-Dihydroxybenzophenone	150								84 5		
379	5-Amino-2-bromophenol	150 d							135 6			
380	2-Amino-5-bromophenol	150										O,N-Dibenzoyl, 133 4, H <sub>2</sub> SO <sub>4</sub> salt, 239 40
381	1-Hydroxyanthracene (1-Anthrol)	150-3, br, al								128-30		Me eth, 70, Et eth, 69
382	2-Amino-4-chloro-6-nitrophenol	152										N-Acetyl, 150 60, yel

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	$\alpha$ Naphthylurethane	$p$ -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	$p$ Toluene sulfonate	Acetate	Benzoate	Miscellaneous
383	4-Hydroxyazobenzene (4-Benzeneazophenol)	152, al								89, 84 5, yel, al	136-8, yel, al	Hydrochloride, 169 HNO <sub>3</sub> → 2,4-Dinitrophenol, 113 Propionate, 75, red
384	Tribromophloroglucinol	152.3 (anh), w								mono 169, bz-pet eth, tri 181.3, al		Me eth, 123, bz Tri-Me eth 145, al Di-Et eth, 63 5, w-ac a, Tri-Et eth, 102 4, ac a
385	4-Amino-2-chlorophenol	153							116-7, aq al			N-Acetyl, 144 O,N-Diacetyl, 124 Me eth, 62
386	2,2'-Dihydroxy-5,5'-dimethylbiphenyl	153-4, w								di 88		Di-formate, 61, 70% al
387	2-Amino-5-chlorophenol	154, aq al										O,N-Dibenzoyl, 140, al Me eth, 46, Hydrochloride 226 d
388	1,2,4-Trihydroxynaphthalene (1,2,4-Naphthalenetriol)	154								tri 134.5		
389	6-Hydroxybiphenyl-2-carboxylic acid	154 (anh)							177, ac a	88-9, al	121, 150	Benzenesulfonate, 104-5 Butyrate, 59-60
390	4-Amino-3-nitrophenol	154, dk red							134, al	185		N-Acetyl, 218, yel, w O,N-Diacetyl, 146, O-m-nitrobenzenesulfonate, 184
391	2-Azoxyphenol (2,2'-Dihydroxyazoxybenzene)	154.5								di 150, bz al	di 108 al	Di-Me eth 81 Di-Et eth, 102
392	3,5-Stilbenediol (3,5-Dihydroxystilbene, Pinosylvyn)	155.5-60, ac a								di 100-i me al	150.1 ac a me al	Me eth, 122-3, ac a Di-Me eth, 56 7 me al
393	1-Hydroxyphenanthrene (1-Phenanthrol)	156, eth								135-6, al		Me eth, 105, me al, Picrate 182, or-red, me al
394	4-Iodo-3-nitrophenol	156, yel, al								107.5		Me eth, 62, Et eth, 63.5
395	1,4,5-Trichloro-2-naphthol	157-8, ac a								129		
396	9-Hydroxyphenanthrene (9-Phenanthrol)	158, bz, 153								77-8, al	99-100	Me eth, 95-6, me al, Picrate, 185, red, Propionate, 95, ac a
397	5-Nitroresorcinol	158, w								di 105		Me eth, 141-2, yel, Di-Me eth, 89, eth-et ac, Et eth, 80, w
398	4,4'-Dihydroxydiphenylmethane	158, w								di 69-70, al	di 156, al	Di-Me eth, 52, Di-Et eth, 38-9
399	2,4,6-Tri-iodophenol	158-9, w-al					181			156, bz	137	Me eth, 98-9, bz Et eth, 83, eth

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids ( Listed in order of increasing m.p.)\* ( Continued )**

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthylurethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> Toluene sulfonate	Acetate	Benzoate	Miscellaneous
400	Salicylic acid (2-Hydroxybenzoic acid)	158.3	211 <sup>20</sup>			205, me al				135, wh	132	Aryloxyacetic acid, 191, Amide, 142, Anilide, 136, <i>p</i> -Toluidide, 156
401	4-Amino-2,3,6-trichlorophenol	159, al								153, yel		N-2,4-Dinitrophenyl, 211, or-red
402	4-Amino-3-chlorophenol	160										N-Acetyl, 121
403	6-Amino-2,4-dinitro-3-methylphenol (6-Amino-2,4-dinitro- <i>m</i> -cresol)	160, al										N-Acetyl, 225, yel
404	2,2'-Dihydroxychalcone	160-1								<i>di</i> 85.5-60	<i>di</i> 114	2-Me eth, 112, al 2-Et eth, 61, al N-Acetyl, 261, yel, ac a, Di-Me eth 136.7, red aq al
405	4-Amino-6-nitrosorcinol	160-1 d, eth-lgr										
406	4,4'-Dihydroxy-3,3'-dimethylbiphenyl	160-1								<i>di</i> 131, al, 135.5	185, ac a	
407	2,3-Dihydroxynaphthalene (2,3-Naphthalenediol)	160.1, w									<i>di</i> 235	Me eth, 108, Di-Me eth, 116.5, lgr, Et eth, 109-10, Di-Et eth, 96-7, 2-Naphthylamine add comp 168
408	1,2-Dihydroxyanthracene (1,2-Anthracenediol)	160-2								<i>di</i> 157.0-7.5, al-ac a		
409	6-Retenol (6-Hydroxyretene)	161, xyl							110.5-11	134-5		Picrate, 152-2.5, red, al
410	5-Amino-2-methylphenol (5-Amino- <i>o</i> -cresol)	161, w							111-2, aq al			N-Acetyl, 225, N,N-Diacetyl, 132-3, O,N-Dibenzoyl, 162, Me eth, 58
411	4,4'-Dihydroxytriphenylmethane	161, w-al								<i>di</i> 109.10		Di-Me eth, 100.1, chl-me al
412	3-Hydroxyphthalic acid	161 d								114-6	148	
413	1,2,3,4-Tetrahydroxybenzene (Apionol, Phenetrol)	161, pink, et ac								<i>tetra</i> 142	<i>tetra</i> 191.2	1,4-Di-Me eth, 106, Tetra-Me eth, 89
414	5-Amino-2-nitrophenol	162, or-yel, w										N-Acetyl, 221, yel, ac a, O,N-Diacetyl, 149, w
415	1,3,4-Trichloro-2-naphthol	162								133.5-40, ac a		
416	2-Amino-5-methylphenol (6-Amino- <i>m</i> -cresol)	162 d										N-Benzoyl, 169, acet-pet eth, O,N-Dibenzoyl, 162.3, me al, Me eth, 171, 50% al
417	1-Amino-2,4-dihydroxynaphthalene	162 (at 130 → vlt)										O,O,N-Triacetyl, 155-6, bz

\*Derivative data given in order m.p., crystal color, solvent from which crystallized



**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthylurethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> Toluene sulfonate	Acetate	Benzoate	Miscellaneous
418	2,4'-Biphenol (2,4'-Dihydroxybiphenyl)	162 3	342							<i>di</i> 94, <i>al</i>		Di-Me eth, 70
419	2,5-Dimethylresorcinol (2,6-Dihydroxy- <i>p</i> -xylene)	163, bz	277 80							<i>di</i> 69, <i>al</i>		Me eth, 118-21, bz
420	2-Amino-3,5-dimethylphenol	163, bz								186 7		O,N-Diacetyl, 87-8, N-Benzoyl, 211 2, <i>al</i> O,N-Dibenzoyl, 148-9, <i>me al</i> , Hydrochloride, 270 80, <i>dil</i> HCl
421	4-Nitro-1-naphthol	164, w										<i>m</i> -Nitrobenzenesulfonate, 135, Me eth, 81, <i>yel</i> , bz 85-6, Et eth, 120, <i>al</i> , 116 7
422	3,5-Dinitrocatechol (1,2-Dihydroxy-3,5-dinitrobenzene)	164								120, <i>di</i> 112 4, 124, <i>al</i>		1-Me eth, 123, 2-Me eth, 80 Di-Me eth, 102, <i>al</i> , 1-Et eth, 155, <i>al</i> , Di-Et eth, 78 94 5
423	2,2'-Dihydroxy-6,6'-dimethylbiphenyl	164								<i>di</i> 87, <i>al</i>	<i>di</i> 136, <i>al</i>	
424	2-Amino-3,4-dihydroxynaphthalene	164								<i>di</i> >200 <i>d</i>		N-Acetyl, 170 <i>d</i> , 3-O,N-Diacetyl, 195 <i>d</i> , <i>acet</i>
425	2,6-Dibromohydroquinone	164								<i>di</i> 117		
426	2-Benzoylphloroglucinol (2,4,6-Trihydroxybenzophenone)	165									<i>tri</i> 125-6	2,4-Di-Me eth, 83, 2,6-Di-Me eth, 178-9
427	5-Amino-3-nitrophenol	165, <i>yel</i>										N-Acetyl, 260-70, <i>et ac</i>
428	2-Methoxy-4-nitrophenol	165 <i>d</i> , <i>yel</i> , <i>chl</i>								156-8	188, <i>yel</i> , <i>al</i>	Me eth, 105 6
429	3-Amino-4,5-dimethylphenol	165, <i>eth</i> , <i>br</i> , (173-5, <i>subl</i> )										N-Acetyl, 191 ( <i>sinters</i> , 184), O,N-Diacetyl, 157, <i>al</i> , O,N,N-Triacetyl, 100-1, <i>al</i> , N-Benzoyl, 195-6
430	1,2,3,5-Tetrahydroxybenzene	165									<i>tri</i> 74	1,3-Di-Me eth, 159, 83, 1,2,3-Tri-Et eth, 105
431	4-Phenylphenol (4-Hydroxybiphenyl)	165	305 8	167 5					177, <i>ac a</i> , 179, <i>al</i> - <i>acet</i>	88-9, 87-8, <i>al</i>	150-1, <i>al</i>	<i>p</i> -Phenylazobenzoate, 213 5-4 0, 2,4-Dinitrophenyl ether, 118
432	4-Amino-2-bromophenol	165, 155										N-Benzoyl, 145, O,N-Dibenzoyl, 192
433	Benzeneazocatechol (3,4-Dihydroxyazobenzene)	165 <i>d</i> , <i>dk</i> <i>red</i> , <i>al</i>										3-Me eth, 70-1, <i>red</i> , <i>lgr</i> , Di-Me eth, 53-4, <i>red</i> , <i>lgr</i> , 44-5
434	4-Amino-2-chloro-3-nitrophenol	165 5 <i>d</i> , <i>bz</i>										N-Acetyl, 184-5, Et eth, 74, or

\* Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	$\alpha$ -Naphthyl urethane	<i>p</i> -Nitro benzoate	3,5-Di nitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
435	4-Amino-2,5-dinitrophenol	166-7, al										N-Acetyl, 144-5, Me eth, 153, bz-lgr, red, Et eth, 139
436	4-Amino-2,6-dinitro-3-methylphenol (4-Amino-2,6-dinitro- <i>m</i> -cresol)	167, red, 50% al										N-Acetyl, 231 d, ac a, Et eth, 96 7, Hydrochloride, 200 d, dl, HCl
437	2-Benzamidophenol (2-Hydroxybenzanilide)	167 d							109-10, al	134 40, al		Me eth, 60
439	2,3,4-Trichloro-1-naphthol	168, lgr								123-4		
440	2-Hydroxyphenanthrene (2-Phenanthrol)	168, al								142-3	139-40, al	Et eth, 112, al, Picrate, 156, red
441	1,5-Di-(2-hydroxyphenyl)-1,4-pentadiene-3-one	168								<i>dt</i> 128, al	135, al	Di-Me eth, 125, al, Di-Et eth, 89, al
442	3,5-Diaminophenol	168-70										3,5-Diacetyl, 195
443	4-Acetamidophenol (4-Hydroxyacetanilide)	169								150-1		
444	2-Amino-4,6-dinitrophenol (Picramic acid)	169, dk red, al										N-Acetyl, 201, N-Benzoyl, 230, 220, N- <i>p</i> -Toluene-sulfonyl, 191
445	4-Amino-2-chloro-5-nitrophenol	169 5 d										N-Acetyl, 166, yel, Et eth, 128 5, or
446	3,3'-Dihydroxybenzophenone	170								89-90	101-2	
447	1,4-Dihydroxy-2-methylnaphthalene (2-Methyl-1,4-naphthohydroquinone)	$\alpha$ 170, $\beta$ 60, ac a								<i>dt</i> 113, al	181	
448	4-Amino-2,6-dinitrophenol (Isopicramic acid)	170, br, w										N-Acetyl, 182, N-Benzoyl, 263, 250, Me eth, 212, Et eth, 172
449	Benzeneazoresorcinol (2,4-Dihydroxyazobenzene)	170, dk red								<i>dt</i> 104, or-red, al		Di-Me eth, 92, red, al, Di-Et eth, 70 yel-red, al
450	3,4-Diaminophenol	170 2, 167 8, unstable										N,N'-Diacyl, 205-7, 3,4-Dibenzoyl, 203 5, 1,3,4-Tribenzoyl, 225, Et eth, 71 2 b p 294-6
451	5-Nitro-1-naphthol	171, dk yel-red, w								114, w-al	109, me al	Me eth, 96-7, yel pet eth
452	Hydroquinone (1,4-Dihydroxybenzene)	171, 172	286	<i>dt</i> 224, 205 7	<i>dt</i> 258, al	<i>dt</i> 317	<i>dt</i> 186	<i>mono</i> 98-9, bz, <i>dt</i> 159, 25% al	<i>dt</i> 123, w	<i>dt</i> 199, 204 (cor), tol		Aryloxyacetic acid, 250, 2,4-Dinitrophenyl ether, 243-6, N,N-Diphenylurethane, 250

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	$\alpha$ Naphthyl urethane	<i>p</i> -Nitrobenzoate	3,5-Di nitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
453	2-Azophenol (2,2'-Dihydroxyazobenzene)	172, yel, bz								<i>di</i> 150, or -red		Di-Me eth, 153, or, Di-Et eth, 131, red
454	2,3,4-Trihydroxyacetophenone (Gallacetophenone)	173 192 0-2 5								2,4- <i>di</i> 107-8, 3,4- <i>di</i> 78-81, <i>tri</i> 85		Semicarbazone, 225 d, Oxime, 162-3, Picrate, 133
455	3,5-Dinitrosalicylic acid	173-4 (anh)									163	Amide, 181, Amide, 180 (subl), 194
456	2-Aminophenol (2-Hydroxyaniline)	174									175	N-Acetyl, 209, 201, N-Benzenesulfonyl, 141, N- <i>p</i> -Toluenesulfonyl, 146
457	3-Benzamidophenol (3-Hydroxybenzamide)	174, tol									153	Et eth, 103
458	4-Amino-2-methylphenol (4-Amino <i>o</i> -cresol)	175, bz							109-10, bz - lgr			N-Acetyl, 179, O,N-Dibenzoyl, 194, ac a, Me eth, 59 0-9 5, 92-3, aq al
459	1,6,7-Trihydroxynaphthalene (1,6,7-Naphthalenetriol)	175								<i>tri</i> 143 4		
460	4-Nitrocatechol	176, yel, w								<i>di</i> 98	<i>di</i> 156, al	Di-Me eth, 96, w-al, Di-Et eth, 73 5, pa yel
461	1,4-Dihydroxynaphthalene (1,4-Naphthalenediol, 1,4-Naphthohydroquinone)	176, 192								<i>di</i> 128 30, al	<i>di</i> 169, ac a	Me eth, 131, Di-Me eth, 85, CS <sub>2</sub>
462	1,7-Dihydroxynaphthalene (1,7-Naphthalenediol)	178, bz		203 4		182-3				<i>di</i> 108, bz	<i>di</i> 101 5, 113-5	Di-Et eth, 67
463	1,2-Dihydroxyphenanthrene (1,2-Phenanthrenediol)	178, w -al								<i>di</i> 147, me al		Di-Me eth, 100 2, lgr
464	4-Amino-6-isopropyl-3-methylphenol (4-Amino-6-isopropyl- <i>m</i> -cresol)	178-9, bz										N-Benzoyl, 178-9, O,N-Dibenzoyl, 166-7, aq al, Hydrochloride, 255
465	1,8,9-Trihydroxyanthracene (1,8,9-Anthracenetriol, Anthralin)	178 80, 176 7								<i>tri</i> 209 10		
466	4-Amino-3-methylphenol (4-Amino- <i>m</i> -cresol)	179, 50% al									92, pet eth	N-Acetyl, 138, Hydrochloride, 215, Me eth, 29-30
467	2,5-Dihydroxyphenanthrene (2,5-Phenanthrenediol)	180, xyl								<i>di</i> 144, w -ac a		Di-Me eth, 117, ac a
468	9,10-Dihydroxyanthracene (9,10-Anthradiol)	180, yel								<i>di</i> 260, ac a	<i>di</i> 292, yel xyl - chl	Di-Me eth, 202, bz, Di-Et eth, 148, bl fluor, al

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthylurethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> Toluene sulfonate	Acetate	Benzoate	Miscellaneous
469	<b>1,2,5,8-Tetrahydroxynaphthalene</b> (1,2,5,8-Naphthalenetetrol)	180 d								<i>tetra</i> 202		
470	<b>4-Hydroxy-3-iodo-5-methoxybenzaldehyde</b> (5-Iodovanillin)	180								105-6	135 5-6 5	Oxime, 178 9 Semicarbazone, 187 8 d
471	<b>6-Nitro-1-naphthol</b>	181 2								121		
472	<b>4-Amino-3,5-dimethylphenol</b>	181 2, chl										N-Acetyl, 178 80 N-Benzyl, 104 5, Me eth, 43, pet eth
473	<b>2-Amino-4-nitroresorcinol</b>	182, br, aq al										N-Acetyl, 213, yel
474	<b>3-Azoxyphenol</b> (3,3'-Dihydroxyazoxybenzene)	183								<i>di</i> 102, 50% al	<i>di</i> 75, ac a 144	Di-Me eth, 49 50, 47 6 Me eth, 62, Et eth, 76 (71), Hydrochloride, 167-77
475	<b>N-Benzylidene-4-aminophenol</b>	183										O,N-Diacetyl, 150, 2,4-Dinitrobenzoyl, 204 5 (cor), N- <i>p</i> -Toluenesulfonyl, 253
476	<b>4-Aminophenol</b> (4-Hydroxyaniline)	184 (subl)				178 5 (cor)				168		9-Me eth, 131 2, bz -pet eth Di-Me eth, 113 4, me al
477	<b>1,9-Dihydroxyphenanthrene</b> (1,9-Phenanthrene-diol)	184 5, bz								<i>di</i> 154-5, w-al		Di-Me eth, 171 5, Dioxime, 242, Phenylhydrazone, 233
478	<b>4,6-Diacetylresorcinol</b> (Resodiacetophenone)	185, al								<i>di</i> 120	<i>mono</i> 214-5, <i>di</i> 118	Di-Me eth, 171 5, Dioxime, 242, Phenylhydrazone, 233
479	<b>4-Amino-2-naphthol</b>	185							137			O,N-Dibenzoyl, 309
480	<b>7-Hydroxy-4-methylcoumarin</b> (4-Methylumbelliferone)	185 6, al		155-6	143					150, al	159-60, al	Me eth, 159, <i>m</i> -Nitrobenzoate, 210-11, Picrate, 108
481	<b>3-Amino-4-nitrophenol</b>	185-6, or, w										N-Benzoyl, 166, Me eth, 131, Et eth, 105-6
482	<b>1,2,6-Trihydroxynaphthalene</b> (1,2,6-Naphthalenetriol)	188									<i>tri</i> 262	
483	<b><math>\alpha</math>,2,4-Trihydroxyacetophenone</b> ( $\omega$ -Hydroxyresacetophenone)	189								<i>tr.</i> 129	$\alpha$ - <i>mono</i> 200	$\alpha$ -Me eth, 136, <i>p</i> -Nitrophenylhydrazone, 205 d, Oxime, 105-7
484	<b>2,7-Dihydroxynaphthalene</b> (2,7-Naphthalenediol)	190, 185-6, w							150, chl	<i>mono</i> 171-2, me al, <i>di</i> 136, w	<i>mono</i> 199, me al, <i>di</i> 139, al	Aryloxyacetic acid, 149, N,N-Diphenylurethane, 176, Me eth, 117 Di-Me eth, 139, Di-Et eth, 104, al
485	<b>1,4,5,8-Tetrahydroxynaphthalene</b> (1,4,5,8-Naphthalenetetrol)	190								<i>tetra</i> 277 9		

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	$\alpha$ Naphthyl urethane	<i>p</i> -Nitro benzoate	3,5-Di nitro benzoate	Bromo derivative	<i>p</i> Toluene sulfonate	Acetate	Benzoate	Miscellaneous
486	1,5-Diacetyl-2,3,4-tri-hydroxybenzene (4,6-Diacetylpyrogallol Gallodiacetophenone)	190 l, w								<i>mono</i> 207-9	<i>tri</i> 189	Tri-Me eth, 73-4
487	3,9-Dihydroxyacridine	190 2 lt br → dk in air al										9-Me -3-Et eth, 144, yel, w In al → grn fluor
488	Pentachlorophenol	190 2							145	149-50	164-5, 159	Aryloxyacetic acid, 196
489	5-Amino-2-naphthol	191										O,N-Diacetyl, 187, O,N-Dibenzoyl, 223
490	1,4-Dihydroxynaphthalene (1,4-Naphthalenediol)	192								<i>di</i> 128-30	<i>di</i> 169	
491	5-Amino-1-naphthol	192										O,N-Dibenzoyl, 276
492	Tetrabromocatechol	192-3								<i>di</i> 215-6	<i>di</i> 197-8, bz - lgr	Me eth, 162-3, Di-Me eth, 151-2, 118-20
493	6-Hydroxyquinoline	193, al							98	36 8	230-1, ac a	Methiodide, 236 d, Picrate, 235 6
494	3-Methyl-2,4,5,6-tetra-bromophenol (2,4,5,6-Tetrabromo- <i>m</i> -cresol)	194, ac a								165 6	153-4	Me eth, 145 6, al, Et eth, 108, eth
495	1,5-Dichloro-4,8-dihydroxynaphthalene	194, ac a								<i>4-mono</i> 148-60, ac a <i>di</i> 154, 143, acet	<i>4-mono</i> 157-8, ac a, <i>di</i> 179, acet	
496	1,6-Dinitro-2-naphthol	195 d							181			Me eth, 204, 198, Et eth, 144, yel, Alc NH <sub>3</sub> at 160° → 1,6-dinitro-2-naphthylamine, 248, Oxid → 4-nitrophthalic acid, 165
497	5,6-Dihydroxyacenaphthene (5,6-Acenaphthenediol)	196-9, bz								<i>di</i> 194-5		
498	1,2,7-Trihydroxynaphthalene (1,2,7-Naphthalenetriol)	197								181-2		
499	4-Methyl-2,3,5,6-tetra-bromophenol (2,3,5,6-Tetrabromo- <i>p</i> -cresol)	199								156		
500	2-Hydroxyquinoline	199										2-Ph eth, 69
501	2-Amino-4-methyl-5-nitrophenol (2-Amino-5-nitro- <i>p</i> -cresol)	199-200 d										N-Acetyl, 242, ac a, Me eth, 132, yel
502	6-Amino-1-naphthol	199 5										O,N-Diacetyl, 130, N-Benzoyl, 203, O,N-Dibenzoyl, 230
503	Hexahydroxybenzene	200 d								<i>hexa</i> 203	<i>hexa</i> 313	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthylurethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
504	<b>Methylenedi-2-naphthol</b> (2,2'-Dihydroxy-1,1'-dinaphthylmethane)	200, ac a								<i>di</i> 214, al		Di-Me eth, 144-7, al, Picrate, 178 9, red-br
505	<b>3-Hydroxybenzoic acid</b>	200								131		Aryloxyacetic acid, 206, Amide, 170, <i>p</i> -Bromophenacyl ester, 176
506	<b>Methyl gallate</b> (Methyl 3,4,5-trihydroxybenzoate)	200-1								<i>tri</i> 120, 120 2, al	<i>tri</i> 139, al	
507	<b>3-Hydroxyquinoline</b>	200-1, bz							90			Picrate, 240 5
508	<b>7-Amino-2-naphthol</b>	201, 208									177	N-Acetyl, 232, O,N-Diacetyl, 156, N-Benzoyl, 243-6, O,N-Dibenzoyl, 181
509	<b>4-Amino-3-methyl-2-nitrophenol</b> (4-Amino-2-nitro- <i>m</i> -cresol)	201, al										O,N-Diacetyl, 127 8
511	<b>2-Acetamidophenol</b> (2-Hydroxyacetanilide)	201 3, 209, aq al								122	140	O,N-Diacetyl, 77
512	<b>2-Acetylhydroquinone</b> (2,5-Dihydroxyacetophenone)	202								<i>di</i> 68	<i>di</i> 113	<i>p</i> -Nitrophenylhydrazone, 215-6, Oxime, 149-50
513	<b>2,8-Dihydroxyphenanthrene</b> (2,8-Phenanthrenediol)	202, w -al								<i>di</i> 125, al		
514	<b>4-Hydroxy-4'-nitrobiphenyl</b>	203, 200-1							159, bz	138 9, lgr	208-10, ac a	Me eth, 111, yel., al, 3,5-Dinitro deriv, 197-8
515	<b>3,5-Dimethoxy-4-hydroxybenzoic acid</b>	205								191	229-32	
516	<b>4-Hydroxycoumarin</b> (Benzotetronic acid)	206, 232 3								103		Me eth, 124, w
517	<b>2,3,5-Trihydroxyacetophenone</b>	206-7, yel, ac a								<i>tri</i> 106-7, lgr	<i>tri</i> 106-7	<i>p</i> -Nitrophenylhydrazone, 241-2 d, w -al
518	<b>2,4,5-Trihydroxyacetophenone</b>	206-7, red								2,4- <i>di</i> 165-6, bz		
519	<b>6-Chloro-3-hydroxy-4-methylbenzoic acid</b>	206-8									146	Amide, 239-40, Anilide, 222
520	<b>8-Amino-2-naphthol</b>	207 d										O,N-Diacetyl, 178, O,N-Dibenzoyl, 208
521	<b>3-Azophenol</b> (3,3'-Dihydroxyazobenzene)	207, yel								<i>di</i> 144, yel, al	<i>di</i> 188, w -al	Di-Me eth, 73-4, Di-Et eth, 91, yel
522	<b>2-Amino-5-nitrophenol</b>	207-8, or, 201-2, w							188, yel, al			N-Acetyl, 271-2, O,N-Diacetyl, 187, Me eth, 139
523	<b>2-Methyl-3,4,5,6-tetrabromophenol</b> (3,4,5,6-Tetrabromo- <i>o</i> -cresol)	208								154		
524	<b>2,6-Dichloro-3,4,5-tribromophenol</b>	209									202	Me eth, 143-4

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	$\alpha$ Naphthyl urethane	<i>p</i> Nitro benzoate	3,5-Di nitro benzoate	Bromo derivative	<i>p</i> -Toluene sul fonate	Acetate	Benzoate	Miscellaneous
525	4-Hydroxy-3-methoxybenzoic acid (Vanillic acid)	210 (subl)				140 l d				110, w	178, aq al	Hydrazide, 207, Phenylhydrazide, 150 2 5
526	4,4'-Dihydroxybenzophenone	210									156, 152	Me eth, 151-2, Di-Me eth, 146, 2,4-Dinitrophenylhydrazone, 190-2
527	<i>cis</i> -1,2-Dihydroxynaphthene ( <i>cis</i> -Acenaphthylene glycol)	212 3, w								<i>mono</i> 122-3, al, <i>di</i> 130, me al		
528	4-Hydroxy-4'-nitroazobenzene	212 3 219 0-9 5								147, or	195, or	Me eth, 157 5 8 0
529	6-Amino-2-naphthol	213 d										O,N-Diacetyl, 220
530	2,4-Dihydroxybenzoic acid	213, 216 d										Amide, 222, Anilide, 126-7, <i>p</i> -Nitrophenyl ester, 189
531	Methylphloroglucinol (2,4,6-Trihydroxytoluene)	214-6, et ac								<i>tri</i> 76, lgr		2-Me eth, 91 (+1H <sub>2</sub> O), 117 9 (anh), 4-Me eth, 124, Tri-Me eth, 10 13, b p 140-2 <sup>18</sup>
532	4-Hydroxybenzoic acid	215, 210								187	221-3	Aryloxyacetic acid, 278, Anilide, 198, <i>p</i> -Toluidide, 204
533	4,6-Dinitroresorcinol	215, yel				<i>di</i> 178			<i>mono</i> 135	<i>di</i> 139	<i>di</i> 343-4	Me eth, 113, Di-Me eth 157, Et eth, 77, Di-Et eth, 133
534	4-Chloro-2,3,5,6-tetrabromophenol	215									203	Me eth, 161
535	2,6-Dihydroxynaphthalene (2,6-Naphthalenediol)	215, 218								<i>di</i> 175	<i>di</i> 215	Di-Me eth, 50, bz, Di-Et eth, 162, al
536	1,2,4,5-Tetrahydroxybenzene	215-20								<i>tetra</i> 226-7		2-Me eth, triacetyl, 142, Tetra-Me eth, 103
537	4-Azophenol (4,4'-Dihydroxyazobenzene)	$\alpha$ 216, grn (anh), $\beta$ 216, dk red (anh)								<i>di</i> 198-9, yel, ac a	<i>di</i> 210 5 1 5, 249-51, red-yel, bz	Di-Me eth, 160 5 2 5, me al, Di-Et eth, 157-9, yel, al, 160
538	2-Amino-3-nitrophenol	216 7, red							136			N-Acetyl, 172, Me eth, 75-6
539	4-Benzamidophenol (4-Hydroxybenzanilide)	216 7, 227								171	235	Me eth, 153-4, al, Et eth, 173, aq al, Benzyl eth, 226-7
540	2,5-Dimethylhydroquinone (Hydrophlorone)	217								<i>mono</i> 117, <i>di</i> 135	<i>mono</i> 162-3, pet eth, <i>di</i> 159, me al	Me eth, 90, lgr

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthylurethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
541	Phloroglucinol (1,3,5 Trihydroxybenzene)	217 9, rapid htng , 200 9, slow htng		<i>tri</i> 190 1		283	<i>tri</i> 162	<i>tri</i> 151		<i>tri</i> 104 6, al	<i>tri</i> 173 4, al	Monobenzenesulfonate, 163 4 (anh ) Monobenzenesulfonate, diacetate, 95 6, bz Dibenzenesulfonate, 120-1, bz , Dibenzenesulfonate monoacetate, 81 me al
542	2-Amino-3,5-dinitrophenol	218, yel , al							186			O,N-Di <i>p</i> -Toluene sulfonyl, 188 N Acetyl, 171 Me eth , 181
543	2,2'-Dihydroxy-1,1'-binaphthyl	218								<i>di</i> 109, al	<i>mono</i> 204, <i>di</i> 160	Dipicrate, 175 6, Di-Me eth , 190, Di-Et eth , 90
544	7-Hydroxybenzo [a]pyrene	218 9, yel								194 5, yel	191 2, yel	Me eth , 183 4, pyr <i>p</i> -Nitrobenzyl eth , 252-3
545	Acetylphloroglucinol (2,4,6-Trihydroxyacetophenone, Phloracetophenone)	219, w , 222								<i>tri</i> 103	2- <i>mono</i> 168,4 <i>mono</i> 210-11, <i>tri</i> 117 8	2-Me eth 205 7 4-Me eth , 139 40, Tri-Me eth , 103 Tri-Et eth , 75, aq al
546	1,1'-Dihydroxy-2,2'-binaphthyl	220								<i>di</i> 169		Di-Me eth , 122, lgr
547	3,5-Dihydroxypyrene	220 d , ac a								<i>di</i> 155		Di-Me eth , 177-8
548	3,6-Dihydroxyphenanthrene (3,6-Phenanthrenediol)	221, w -al								<i>di</i> 124 5, al		3-Me eth , 135 6 w -me al Di-Me eth , 104-5, w -me al
549	2,3-Dimethylhydroquinone (3,6-Dihydroxy- <i>o</i> -xylene)	221, sl d , w								<i>mono</i> 174 5, acet - pet eth , <i>di</i> 182, acet - pet eth		Di-Et eth , 68 9
550	3-Hydroxy-2-naphthoic acid	222								184-6		Amide, 218, Amide, 244 <i>p</i> -Toluidide, 222
551	4-Amino-6-chloro-3-methylphenol (4-Amino-6-chloro- <i>m</i> -cresol)	223-5 d										O,N-Diacetyl, 162 O,N-Dibenzoyl, 220
552	4-Azoxyphenol (4,4'-Dihydroxyazoxybenzene)	224 d								<i>di</i> 163, or , al	<i>mono</i> 200, al , 212, bz , <i>di</i> 187-90	Di-Me eth , 118-9 yel , Di-Et eth , 137-8

\*Derivative data given in order m p , crystal color, solvent from which crystallized



**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthylurethane	$p$ -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	$p$ Toluene sulfonate	Acetate	Benzoate	Miscellaneous
553	5-Hydroxyquinoline	224							85			Hydrochloride, 240, Methiodide, 224, Picrate, 187
554	2-Amino-4-chloro-5-nitrophenol	225 d, yel										N-Acetyl 193 Me eth, 132
555	1,2,3,4-Tetrahydroxynaphthalene (1,2,3,4-Naphthalenetetrol)	225								<i>tetra</i> 220		
556	1,8-Dihydroxyanthracene (1,8-Anthracenediol, Chrysazol)	225, yel, al-w								<i>di</i> 184, et ac		Di-Me eth, 198, al, Di-Et eth, 139, al
557	4-Amino-6-nitrocatechol	228, yel										O,O,N-Triacetyl, 207, ac a
558	5-Hydroxycoumarin	229								88 9, 84		Me eth, 85 7
559	2-Hydroxy-5-nitrobenzoic acid	229 30										Amide, 225, Anilide, 224
560	Pentabromophenol	229 5, 225 6								197, 171		Me eth, 173 4, Et eth, 136
561	2,6-Dihydroxyphenanthrene (2,6-Phenanthrenediol)	234, w -al								<i>di</i> 122-3, al	<i>di</i> 252 3	Di-Me eth, 87, me al
562	3-Amino-2-naphthol	235										O,N-Diacetyl, 188, O,N-Dibenzoyl, 184
563	5-Hydroxy-1-naphthoic acid	235								202	241	
564	2,3-Dihydroxyacridine (2,3-Acridinediol)	235 d										Di-Me eth, 107, yel-wh, al
565	Tetrachlorohydroquinone	236 7								<i>di</i> 245	<i>di</i> 233	
566	7-Hydroxyquinoline	238-40, al, (br at 200)							116		88-9, al	Methiodide, 251 d, al, Picrate, 244-5
567	1,7-Dihydroxyanthrone (Euxanthone)	240								7-mono 160, al, <i>di</i> 185, bz	<i>di</i> 221 2, 214	7-Me eth, 130-5
568	1,6-Dihydroxypyrene (1,6-Pyrenediol)	240 d, sinters at 175										Sol red with grn fluor In alkali red soln with bl fluor, Zn dust $\rightarrow$ pyrene, 149-50
569	4-Amino-2,5-dimethylphenol	242 d, al										N-Acetyl, 177 9, al, Et eth, 69 5
570	3,8-Dihydroxyphenanthrene (3,8-Phenanthrenediol)	247, lt red, w -al								<i>di</i> 184, al		Di-Me eth, 117, me al
571	3-Hydroxy-1-naphthoic acid	248								169 70	222-3	Amide, 209-11, Anilide, 112-3
572	2,5-Dihydroxypyridine (2,5-Pyridinediol)	248								5-mono 156		Hydrochloride, 106 (hyd), 154 (anh)
573	1,4-Dihydroxyisoquinoline (1,4-Isoquinolinediol)	>250, ac a turns red at 200								4-mono 207-8		4-Me eth, 171, acet-pet eth
574	2,3-Dihydroxyquinoline (3-Hydroxycarbostyryl, 2,3-Quinolinediol)	257 8, >300								3-mono 211	3-mono 286 7, <i>di</i> 45 6, pet eth	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthylurethane	$p$ -Nitrobenzoate	3,5 Di-nitrobenzoate	Bromo derivative	$p$ -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
575	1,5-Dihydroxynaphthalene (1,5-Naphthalenediol)	265, 258								<i>di</i> 159-61, dil al	<i>di</i> 235, 242, pyr	Di-Me eth, 183 4, Di-Et eth, 130, w-al, 2 Naphthylamine add comp, 229 5
576	2,7-Dihydroxyphenanthrene (2,7-Phenanthrenediol)	265, w-al								<i>di</i> 181 5, al		Di-Me eth, 169-70, me al
577	Phenolphthalein	265 (cor), 261		<i>di</i> 135, bz						<i>di</i> 143, al	<i>di</i> 169, bz-lgr	
578	1,5-Dihydroxyanthracene (Rufol, 1,5-Anthracenediol)	265 d, yel								<i>di</i> 198, et ac		Di-Me eth, 224, me al, Di-Et eth, 179, al
579	4,4'-Biphenol (4,4'-Dihydroxybiphenyl)	274 5, al							<i>di</i> 189 90, bz	<i>di</i> 161, dil al, 164 (cor)	<i>di</i> 241, ac a	Aryloxyacetic acid, 274, Di-Me eth, 173 (subl), Di-Et eth, 176
580	1-Amino-2-naphthol	276 d										O,N-Diacetyl, 206, O,N-Dibenzoyl, 235
581	2,7-Dihydroxyanthracene (2,7-Anthracenediol)	280-5 d, bz, turns dk at 250								282		Di-Me eth, 216 7, ac a, Di-Et eth, 192-3
582	2,3-Dihydroxyanthracene (2,3-Anthracenediol)	282 d, yel								<i>di</i> 175		Di-Me eth, 204, al
583	4,4'-Dihydroxystilbene (4,4'-Stilbenediol)	284, ac a								<i>di</i> 213		Di-Me eth, 214-5, Di-Et eth, 208
584	3,5'-Dimethoxy-5,7,4'-trihydroxyflavonol (Syringetin)	288 9, pa yel, ac a								<i>tetra</i> 224-6		4'-Benzyl eth, 240 1
585	2,7-Dihydroxy-4-methylquinoline	290-300, w-al (+ 1H <sub>2</sub> O), turns br at 280								7-mono 250-4, al	7-mono 288, al	
586	2,6-Dihydroxyanthracene (Flavol 2,6-Anthracenediol)	295-300 d, al, turns dk at 270								<i>di</i> 260 1, ac a		Di-Me eth, 255-6, ac a, Di-Et eth, 230-1
587	Bi- $\alpha$ -naphthol (4,4'-Dihydroxy-1,1'-binaphthyl)	300, 250								<i>di</i> 217		Di-Me eth, 252, Di-Et eth, 211
588	2,8-Dihydroxyacridine (2,8-Acridinediol)	>300, turns red at 275										Di-Me eth, 138-9, Di-Et eth, 142 3
589	2,6-Dibromo-1,5-dihydroxynaphthalene	>300, 224 d turns dk at 200								1-mono 273, <i>di</i> 228	<i>di</i> 262, pyr	1-Acetate, 5-benzoate, 164, Di-Me eth, 161, Di-Et eth, 148
590	3,7-Dihydroxyacridine (3,7-Acridinediol)	324, pa yel, w-al										In al sol $\rightarrow$ grn fluor
591	3,8-Dihydroxypyrene (3,8-Pyrenediol)	330, Tricl-bz-phhydraz, turns dk at 280								<i>di</i> 224, ac a		Di-Me eth, 244, cl-bz

\*Derivative data given in order m p, crystal color, solvent from which crystallized

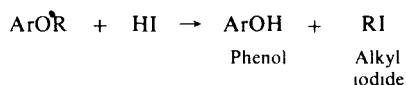
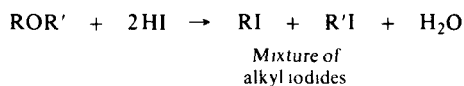
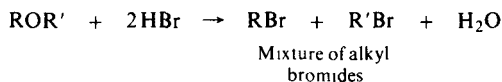
**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	$\alpha$ -Naphthyl urethane	<i>p</i> Nitro benzoate	3,5-Di nitro benzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
592	<b>1,3-Dihydroxyacridone</b>	370								<i>mono</i> 200, yel	<i>mono</i> 295.7	Me eth (i) 203, dk br, (ii) 252, yel, Di-Me eth, 286-7 d, Anil, 269.70, Zn dust $\rightarrow$ acridine, 111

\*Derivative data given in order m p, crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE VIII

*Cleavage to alkyl bromide or alkyl iodide*

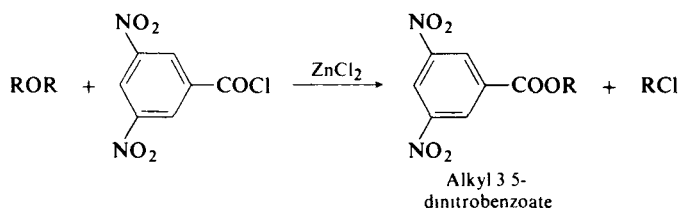


From the ether with concentrated hydrochloric acid

*For directions and examples see* Cheronis, p 543, Linstead, pp 46-7, Shriner, p 116, Vogel, p 316

*NOTE* For directions and examples for preparation of derivatives of alkyl iodides and alkyl bromides formed on cleavage of ethers see explanations and references to Table V, pp 52, 53, 54

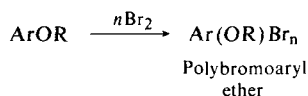
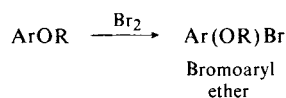
*Alkyl 3,5-dinitrobenzoate \**



From a symmetrical aliphatic ether with freshly fused zinc chloride and 3,5-dinitrobenzoyl chloride

*For directions and examples see* Cheronis, pp 542, 543, Linstead, p 46, Shriner, p 239, Vogel, p 316, Wild, p 96 H W Underwood, O L Baril and G C Toone, *J Amer Chem Soc*, 52, 4087 (1930)

*Bromo derivative*



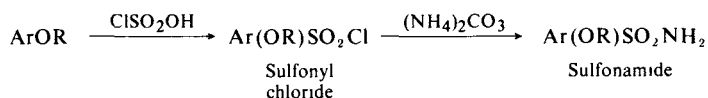
From alkyl aryl or diaryl ether with bromine in glacial acetic acid or chloroform

*For directions and examples see* Cheronis, p 545, Shriner, p 240

From the aromatic ether with bromine in alcohol, acetic acid, ether, chloroform or petrol ether

*See* Wild, pp 98-9, 101, H W Underwood, O L Baril and G C Toone, *J Amer Chem Soc*, 52, 4087 (1930)

*Sulfonamide \**



The sulfonyl chloride is prepared from the aromatic ether with chlorosulfonic acid in chloroform or without solvent. The sulfonamide is obtained from the sulfonyl chloride with ammonium carbonate and/or aqueous ammonia.

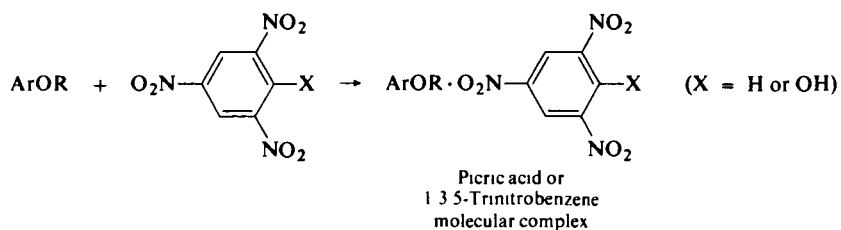
*For directions and examples see* Cheronis, pp 545, 546, Linstead, pp 47, 50, Shriner, p 241, Vogel, p 672, Wild, pp 27, 101, E H Huntress and F H Carten, *J Amer Chem Soc*, 62, 511, 603 (1940)

**\*Derivatives recommended for first trial**

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives.

## EXPLANATIONS AND REFERENCES TO TABLE VIII (Continued)

### *Picric acid and 1,3,5-trinitrobenzene addition complexes*



From the aromatic ether with the aromatic polynitro compound in chloroform

*For directions and examples see* Cheronis, pp 545, 547, Linstead, pp 47, 50, Shriner, p 241, Vogel, p 672, Wild, p 100, O L Baril and G A Megrichian, *J Amer Chem Soc*, 58, 1415 (1936), E K Andersen, *Acta Chem Scand*, 8, 157 (1954)

From the aromatic ether with picric acid in ethanol

*See* V H Dermer and O C Dermer, *J Org Chem*, 3, 289 (1938)

*NOTE* For additional information regarding directions and examples for the derivatization of aromatic ethers (nitration, side-chain oxidation, etc) see explanations and references to Table IV, pp 32, 33, 34

\*Derivatives recommended for first trial

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives

TABLE VIII. ORGANIC DERIVATIVES OF ETHERS  
a) Liquids (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	1,3,5-Tri-nitro-benzene addition compound	3,5-Dinitro benzoate	Miscellaneous
1	Ethylene oxide (Epoxyethane)	10.7	-111.7	1.3614 <sup>4</sup>	0.89713 <sup>4</sup>							HBr → Ethylene bromohydrin, b p 149
2	Ethyl methyl ether	10.8, 10			0.7260 <sup>9</sup>							Maleic anhydride → 3,6-Endoxo- $\Delta^4$ -tetrahydrophthalic anhydride, 125d, 118d, abs eth iodide, b p 72
3	Furan	31.27	-85.6	1.42157	0.9366						93	
4	Diethyl ether (Ethyl ether)	34.60	-116.3, stab, -123.3, unst	1.3526	0.71352							
5	Propylene oxide (1,2-Epoxypropane)	35		1.466	0.830							Heating with dil $H_2SO_4$ → <i>d</i> -propylene glycol, b p 187.4
6	Ethyl vinyl ether	35.75	-115.8	1.3768	0.7589							Dil acid → al + acetaldehyde
7	Methyl <i>n</i> -propyl ether	39		1.3579	0.7356 <sup>3</sup>							
8	Allyl methyl ether	46							$\beta, \gamma$ -di b p 185, $D_4^{20}$ 1.8329			
9	Ethyl isopropyl ether	53.4			0.7211 (0.745 <sup>9</sup> )							Heating with 1% $H_2SO_4$ (sealed tube) → al + isopropyl alcohol
10	<i>tert</i> -Butyl methyl ether	55.2		1.3689	0.7405							Constant boil mixt with w, b p 52.6, with 4% w
11	2,3-Epoxybutane	<i>cis</i> 58 97 <sup>45</sup> <i>trans</i> 53-4 <sup>741</sup>			<i>cis</i> 0.8226 <sup>25</sup> , <i>trans</i> 0.8010 <sup>25</sup>							Normal crude mixt is 65% <i>trans</i> + 35% <i>cis</i>
12	Chloromethyl methyl ether	59		1.3974	1.015	163						
13	$\alpha$ -Butylene oxide (1,2-Epoxybutane)	61-2		1.385 <sup>17</sup>	0.837 <sup>17</sup>							
14	Ethyl <i>n</i> -propyl ether	63.6	<-79	1.36948	0.7386							Constant boil mixt with al, b p 61.2, with 25% al
15	2-Methylfuran (Sylvan)	64		1.434	0.913							
16	Tetrahydrofuran	65		1.407	0.889							
17	Allyl ethyl ether	66-7 <sup>142</sup>		1.3881	0.7651				$\beta, \gamma$ -di b p 193-5			Heating with 2% $H_2SO_4$ → al + allyl alcohol
18	Di-isopropyl ether (Isopropyl ether)	67.5	-60	1.3688	0.726						123, 120-1, $CCl_4$	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VIII. ORGANIC DERIVATIVES OF ETHERS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Picrate	Sulfonamide	Nitro derivative	Bromo derivative	1,3,5-Tri-nitrobenzene addition compound	3,5-Dinitrobenzoate	Miscellaneous
19	<i>n</i> -Butyl methyl ether	70	-115.5	1.3728, 1.3736	0.7455, 0.774							Oxid by alkaline KMnO <sub>4</sub> at 35-40° → ac + methoxyacetic acid
20	<i>tert</i> -Butyl ethyl ether	73.1 (cor)		1.3760	0.7404							Constant boil mixt with w, b p 65.2, with 6% w
21	Tetrahydrofuran	79		1.407	0.855							
22	Chloromethyl ethyl ether	80, 83d		1.40398	1.014							
23	Ethyl isobutyl ether	81.1 (cor)		1.3739 <sup>25</sup>	0.7323 <sup>25</sup>							
24	<i>sec</i> -Butyl ethyl ether	81.2 (cor)		1.3802	0.7503							
25	Isopropyl <i>n</i> -propyl ether	83		1.376	0.7370							
26	Ethylene glycol dimethyl ether	84.7		1.37965	0.8665							
27	Dihydropyran	86		1.440	0.923							
28	<i>tert</i> -Amyl methyl ether	86.3		1.3885	0.7703							Constant boil mixt with w, b p 73.8, with 9% w, Constant boil mixt with me al, b p 62.3, with 50% me al
29	Tetrahydropyran	88		1.421	0.881							
30	Di- <i>n</i> -propyl ether ( <i>n</i> -Propyl ether)	90.1	-122	1.38829	0.74698						74	Constant boil mixt with w, b p 75.4, Constant boil mixt with <i>n</i> -propyl alcohol, b p 85.8
31	<i>n</i> -Butyl ethyl ether	92.3 (cor)	-124	1.3820	0.7505							
32	2,5-Dimethylfuran	94		1.4363 <sup>21, 6</sup>	0.888 <sup>20, 1</sup>				<i>penta</i> 180, chl			Maleic anhydride → 3,6-Endoxo-3,6-dimethyl- $\Delta^4$ -tetrahydrophthalic anhydride, 78, eth
33	$\alpha$ -Chloroethyl ethyl ether	98		1.404	0.966							
34	<i>n</i> -Amyl methyl ether	99-100		1.3873	0.761							
35	<i>tert</i> -Amyl ethyl ether	101		1.3912	0.7657							Constant boil mixt with 13% w, b p 81.2
36	1,4-Dioxane	101.4	11.8	1.4232	1.03361				65-6			Iodine derivative, 84.5, Constant boil mixt with 48 mole % dioxane, b p 82.8

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VIII. ORGANIC DERIVATIVES OF ETHERS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Picrate	Sulfonamide	Nitro derivative	Bromo derivative	1,3,5 Tri nitro benzene addition compound	3,5 Dinitro benzoate	Miscellaneous
37	Ethylene glycol monoethyl monomethyl ether (1-Ethoxy-2-methoxyethane)	102		1.38677	0.8529							
38	Cyclopentyl methyl ether	105		1.4206	0.862							
39	$\beta$ -Chloroethyl ethyl ether	107		1.411	0.989							
40	<i>n</i> -Butyl isopropyl ether	108 <sup>738</sup>		1.3889 <sup>11</sup> <sub>1.461</sub>	0.7594 <sup>15</sup>							Boil HI → <i>n</i> -butyl iodide + isopropyl iodide
41	$\alpha$ -Epichlorohydrin	115.7		1.438	1.181							
42	$\alpha, \alpha'$ -Dichloroethyl ether	116, 114		1.4183 <sup>24</sup>	1.1381 <sup>2</sup>							
43	<i>n</i> -Amyl ethyl ether	118		1.3927	0.762							
44	Di- <i>sec</i> -butyl ether	121		1.3928 <sup>27</sup>	0.760					b p 90.1 $n_D^{25}$ 1.250	75.5	
45	Cyclopentyl ethyl ether	122		1.423	0.853							
46	Di-isobutyl ether (Isobutyl ether)	123			0.7616 <sup>15</sup>						87, 84.5, 5.5	
47	Ethylene glycol mono-methyl mono- <i>n</i> -propyl ether (1-Methoxy 2- <i>n</i> propoxyethane)	124.5		1.39467	0.8472							
48	<i>n</i> -Hexyl methyl ether	126		1.3972	0.772							
49	2-Methoxy-1-propanol	130 <sup>755</sup>									97	$\alpha$ -Naphthylurethane, 60
50	Cyclohexyl methyl ether	134		1.435	0.875							
51	Ethylene glycol monoethyl ether ("Cello-solve", 2-Ethoxy-ethanol)	134.8, 135.1		1.40797	0.9297, 0.9311						75	Miscible with w, with al and with eth, Diphenylurethane, 43, Xanthate, 202.5 (cor), acet abs eth Phenylurethane, 226
52	3-Ethoxy-2-methyl-2-butanol	141										
53	<i>n</i> -Hexyl ethyl ether	142		1.4008	0.772							
54	Di- <i>n</i> -butyl ether (Butyl ether)	142.4, 144	-98	1.3989	0.76829						62.3, 64	
55	Cyclohexyl ethyl ether	149		1.435	0.864							
56	Anisole (Methoxybenzene, Methyl phenyl ether)	153.8, 155 (43 <sup>10</sup> )	-37.5	1.52211	0.99393	79.81, unst in air	113, 110.1, al	2,4-di 86.9, al, 95.5	2,4-di 61, al		87	
57	3-Methoxy-2-methyl-1-propanol	155		1.4140 <sup>27</sup>							64	
58	Diethylene glycol dimethyl ether	162.0	-75	1.4099	0.9440 <sup>30</sup>							

\* Derivative data given in order m p, crystal color, solvent from which crystallized



**TABLE VIII. ORGANIC DERIVATIVES OF ETHERS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Picrate	Sulfonamide	Nitro derivative	Bromo derivative	1,3,5-Tri-nitrobenzene addition compound	3,5-Dinitrobenzoate	Miscellaneous
59	Furfuryl alcohol (2-Furancarbinol)	170		1.4868	1.1351						80-1, pyr	<i>p</i> -Nitrobenzoate, 76, N-Phenylurethane, 45
60	Ethylene glycol mono- <i>n</i> -butyl ether ( <i>n</i> -Butyl "cellosolve")	171 <sup>743</sup>		1.4177	0.9188				172		oil	3-Nitrophthalate, 120
61	Benzyl methyl ether	170-1 (cor)		1.5008	0.9649	115.6						
62	2-Methoxytoluene (2-Methyl anisole, Methyl 2-tolyl ether, 2-Cresyl methyl ether)	171		1.505	0.9853	116, 113.4, pa. yel	137, al	3,5- <i>di</i> 69, pa. yel, me. al	5- <i>mono</i> 63-4, al			Oxid → <i>o</i> -Methoxybenzoic acid, 101
63	Phenyl ethyl ether (Phenetole)	172	-33	1.5080, 1.5074	0.9666	92	150	<i>p</i> - <i>mono</i> 58				
64	Di-isoamyl ether (Isoamyl ether)	172.5		1.409	0.778						60.1	Constant boil mixt with w, b.p. 97.2
65	4-Methoxytoluene (4-Methylanisole, Methyl 4-tolyl ether, 4-Cresyl methyl ether)	173, 176		1.512	0.970	88-9, yel-or	182, al					Oxid → <i>p</i> -Anisic acid, 184-6, 184, w
66	3-Methoxytoluene (3-Methylanisole, Methyl 3-tolyl ether, 3-Cresyl methyl ether)	173, 177 (cor)		1.513	0.972	113.4, yel-or	129.30, al	2- <i>mono</i> 54-5, pet. eth., 2,4,6- <i>tri</i> 92, al				Oxid → <i>m</i> -Methoxybenzoic acid, 110
67	Tetrahydrofurfuryl alcohol	117		1.45167	1.0544						83-4	<i>p</i> -Nitrobenzoate, 46-8, N-Phenylurethane, 61, pet. eth.
68	Phenyl isopropyl ether	178		1.4992	0.975							conc H <sub>2</sub> SO <sub>4</sub> + ac. a → <i>o</i> -Isopropylphenol, b.p. 213-4, m.p. 130
69	$\beta,\beta'$ -Dichloroethyl ether	178		1.4568	1.220							
70	2-Ethoxytoluene (2-Cresyl ethyl ether, Ethyl 2-tolyl ether)	184		1.505	0.953	117.5, 8.5, pa. yel	148-9, al	<i>di</i> 51				Oxid → <i>o</i> -Ethoxybenzoic acid, 25, 19.0-5, well dried
71	Benzyl ethyl ether (Homophenetole)	184-6 (cor)		1.4958	0.9478							Refluxed in bz + P <sub>2</sub> O <sub>5</sub> → Ethylene + Diphenylmethane, 25.1
72	Di- <i>n</i> -amyl ether ( <i>n</i> -Amyl ether)	187.5	-69.3	1.416	0.78298						42.3	
73	Diethylene glycol diethyl ether	188		1.411	0.906							
74	Phenyl <i>n</i> -propyl ether ( <i>n</i> -Propoxybenzene)	188, 189.3 (cor)		1.5014, 1.5011	0.9494 <sub>20</sub>		116.7, al					

\*Derivative data given in order: m.p., crystal color, solvent from which crystallized

**TABLE VIII. ORGANIC DERIVATIVES OF ETHERS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Picrate	Sulfonamide	Nitro derivative	Bromo derivative	1,3,5-Tri-nitrobenzene addition compound	3,5-Dinitrobenzoate	Miscellaneous
75	<b>4-Ethoxytoluene</b> (4-Cresyl ethyl ether Ethyl 4-tolyl ether)	190.5		1.505	0.949	110.1, or yel	138.05, al					Oxid → <i>p</i> -Ethoxybenzoic acid, 198, 195.0-5, al
76	<b>3-Ethoxytoluene</b> (3-Cresyl ethyl ether Ethyl 3-tolyl ether)	190.5		1.506	0.949	114.5 or -yel	110.1 al					Oxid → <i>m</i> -Ethoxybenzoic acid, 137
77	<b>Diethylene glycol monomethyl ether</b>	194		1.4244	1.035 <sub>4</sub> <sup>20</sup>							<i>p</i> -Nitrophenylurethane, 73.5
78	<b>3-Chloroanisole</b>	194					131					
79	<b>2-Chloroanisole</b>	195		1.5433 <sup>25</sup>	1.1865 <sub>4</sub> <sup>25</sup>			95				
80	<b>Diethylene glycol monoethyl ether</b>	196		1.4298	1.023 <sub>20</sub> <sup>20</sup>						oil	<i>p</i> -Nitrophenylurethane, 66
81	<b>4-Chloroanisole</b>	200			1.1851 <sub>4</sub> <sup>25</sup> *		151	2-mono 95				
82	<b><i>n</i>-Butyl phenyl ether</b> ( <i>n</i> -Butoxybenzene)	206		1.5049		110-2, pa yel chl	103.4, al					
83	<b>2-Chlorophenetole</b>	208	17				133	82				
84	<b>2-Bromoanisole</b>	210					140	106				
85	<b>Benzyl isobutyl ether</b>	210.2 (cor)		1.4826	0.9233							
86	<b><i>p</i>-Bromoanisole</b>	215, 216			1.494 <sub>4</sub> <sup>20</sup>		148	88				
87	<b>Methyl thymyl ether</b>	216			0.954 <sub>4</sub> <sup>20</sup>			<i>tri</i> 92				
88	<b>Triethylene glycol dimethyl ether</b>	216	-47	1.4233	0.9871 <sub>20</sub> <sup>20</sup>							
89	<b>1,3-Dimethoxybenzene</b> (Resorcinol dimethyl ether)	217 (cor)	-58, -52	1.4233	1.0552 <sub>25</sub> <sup>25</sup>	56.8, or -yel, unst in air	166-7, al	2,4- <i>di</i> 72, pa yel, al, 4,6- <i>di</i> 157 al, 2,4,6- <i>tri</i> 123-4, pa red, al	4,6- <i>di</i> 140, al			
90	<b>2-Bromophenetole</b>	218					135	98				
91	<b>Benzyl <i>n</i>-butyl ether</b>	219-21 (cor)		1.4833	0.9227							
92	<b>Creosol</b> (4-Methylcatechol 2-methyl ether)	221	5.5	1.5353 <sup>25</sup>	1.0919 <sub>4</sub> <sup>25</sup>	112, yel						
93	<b><i>n</i>-Butyl 2-tolyl ether</b> (2-Butoxytoluene)	223			0.9437 <sub>6</sub> <sup>20</sup>		95-6, al					
94	<b>2-Methoxyaniline</b> (2-Anisidine)	225	5		1.0978 <sub>15</sub> <sup>15</sup>							N-Formyl, 83.5, N-Acetyl, 87-8
95	<b>Di-<i>n</i>-hexyl ether</b> ( <i>n</i> -Hexyl ether)	228-9 <sup>761</sup>			0.7936						54.5-5.5	
96	<b>Safrole</b> (4-Allyl-1,2-methylenedioxybenzene)	233	11	1.5383	1.100	104.05.5, or -red			<i>tri</i> 108, <i>penta</i> 169-70, bz	51		
97	<b>4-Bromophenetole</b>	233, 229	12				145	47				

\* Derivative data given in order *m p*, crystal color, solvent from which crystallized

**TABLE VIII. ORGANIC DERIVATIVES OF ETHERS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	Picrate	Sulfonamide	Nitro derivative	Bromo derivative	1,3,5-Tri nitro benzene addition compound	3,5-Dinitro benzoate	Miscellaneous
98	<b>Resorcinol diethyl ether</b>	235	12.4			109	184		<i>tri</i> 69			
99	<b>Eugenol methyl ether</b> (4-Allyl-1,2-dimethoxybenzene)	244		1.5360	1.0336	114.5, red-br, chl	7		<i>tri</i> 78, abs al			
100	<b>2-Iodophenetole</b>	246			1.800	84			<i>tri</i> 110			
101	<b><i>trans</i>(<math>\beta</math>)-Isosafrole</b> (1,2-Methylene-dioxy-4-propylbenzene)	248	6.8	1.5782	1.122	74.5, dk red, chl			<i>di</i> 52-3, eth, <i>tri</i> 109	85.6, brt scar		
102	<b>3-Methoxyaniline (3-Anisidine)</b>	251				169d, yel						N-Formyl, 57, N-Acetyl, 81, N- <i>p</i> -Toluenesulfonyl, 68
103	<b>Di-<i>n</i>-heptyl ether</b> ( <i>n</i> -Heptyl ether)	263, 260		1.427	0.8056 <sup>20</sup>						47	
104	<b>Isoeugenol methyl ether</b>	264	16-7	1.5692	1.0528	42.5, dk red, chl			<i>di</i> 101.0, 5, abs eth	69-70, brt scar		Oxid → Veratric acid, 181
105	<b>Tetraethylene glycol dimethyl ether</b>	266, 275		1.432	1.009							
106	<b>Methyl 1-naphthyl ether</b> (1-Methoxynaphthalene)	271 (cor)	< -10	1.6940 <sup>25</sup>	1.09159	129.5, 30.5, yel-or, chl	156.7, al	2- <i>mono</i> 80, 4 <i>mono</i> 85, yel, al	4- <i>mono</i> b p 181-2, 5- <i>mono</i> 67.5, 80, <i>x-mono</i> 46, al, 2,4- <i>di</i> 54.5, al	139.40, 137.8, yel		
107	<b>2-Nitroanisole</b>	277	10	1.562	1.254							Reduct → <i>o</i> -anisidine, b p 225
108	<b>Ethyl 1-naphthyl ether</b> (1-Ethoxynaphthalene)	280.5 (cor)	5.5	1.5973 <sup>28</sup>	1.074	118.5, 9.0 (cor)	164-5, al	2- <i>mono</i> 84, 4- <i>mono</i> 116-7, al	4- <i>mono</i> 48, al	125.5, yel		
109	<b>Dibenzyl ether</b> (Benzyl ether)	290, 300d	3.6		1.0428	77.8, or-yel, chl			<i>di</i> 107-8, al		112	
110	<b>Isoamyl 1-naphthyl ether</b>	317.5 (cor)	< -10	1.57049 <sup>14,2</sup>	1.00689 <sup>14,2</sup>	96.0-7.0						

\*Derivative data given in order: m.p., crystal color, solvent from which crystallized

TABLE VIII. ORGANIC DERIVATIVES OF ETHERS

b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point, °C	Boiling point, °C	$n_D^{20}$	$D_4^{20}$	Picrate	Sulfonamide	Nitro derivative	Bromo derivative	1,3,5-Tri-nitrobenzene addition compound	3,5-Dinitrobenzoate	Miscellaneous
1	<b>4-Chlorophenetole</b> (1-Chloro-4-ethoxybenzene)	21	212	1 5227 <sup>19</sup>	1 1231 <sup>20</sup>		134		2,6 <i>di</i> 54			
2	<b>Veratrole</b> (1,2-Dimethoxybenzene)	22 5	207, 205	1 5287 <sup>21</sup>	1 080	56 7, red	135 6, al	95	4,5- <i>di</i> 92-3			
3	<b>Anethole</b> (1-Methoxy-4-propenylbenzene)	22 5, al	235	1 558	0 989 <sup>22</sup>	69 70d, or-red, al			<i>di</i> 67, eth, 65, 62 4, <i>tri</i> 108, pet eth			
4	<b>4-Methoxybenzyl alcohol</b> (Anisyl alcohol)	24	151 <sup>27</sup> , 138 <sup>14</sup>									Phenylurethane, 93 <i>p</i> -Nitrobenzoate, 94
5	<i>n</i> -Amyl 2-naphthyl ether	24 5	327 5 (cor)	1 5587 <sup>30</sup>		66 5 7 0, or, h al	159	<i>di</i> 135	<i>di</i> 58			
6	<b>4-Iodophenetole</b> (1-Ethoxy-4-iodobenzene)	27	252					96				
7	<b>Diphenyl ether</b> (Phenyl ether)	28	259	1 5826 <sup>24</sup>	1 073	110	<i>di</i> 159, al	4,4'- <i>di</i> 144 4, al, 2,4,2',4'- <i>tetra</i> 195 7, pa yel, ac a	4,4'- <i>di</i> 54 5, al			
8	<b>Isoamyl 2-naphthyl ether</b>	28 0 5	321 0 (cor)			93 5-4 0, al						
9	<b>2-Methoxyphenol</b> (Guaiacol, Catechol monomethyl ether)	28 2	205	1 5441	1 1287 <sup>20,4</sup> <sub>vac</sub>	86 7			4,5,6- <i>tri</i> 116, al		141 2 (cor), al	
10	<b>2-Methoxybiphenyl</b> (2-Biphenyl methyl ether)	29, pet eth	274					5- <i>mono</i> 95 6, pa yel, me al				
11	$\beta$ -Bromoethyl phenyl ether	32							56			
12	<b>Isobutyl 2-naphthyl ether</b>	33	304			84 5						
13	<b>Didodecyl ether</b> (Dilauryl ether)	33, 28-30	190-5 <sup>1</sup>									
14	<b>2-Ethoxybiphenyl</b> (2-Biphenyl ethyl ether)	34	132 <sup>6</sup>									
15	<i>sec</i> -Butyl 2-naphthyl ether	34	298 5 (cor)			86						
16	<b>3-Ethoxybiphenyl</b> (3-Biphenyl ethyl ether)	35	158 <sup>6</sup>									
17	<b>3-Nitrophenetole</b>	35	284									Reduct → <i>m</i> -Phenetidine, (Picrate, 158)
18	<i>n</i> -Butyl 2-naphthyl ether	35 5	309 (cor)			67						
19	<b>Ethyl 2-naphthyl ether</b> (Neonerolin)	36, 37	282 (cor)	1 5932 <sup>17</sup>	1 064	101	161-3, al		1- <i>mono</i> 66, pet eth, 1,6- <i>di</i> 94, pet eth			
20	<b>3-Aminodiphenyl ether</b>	37, lgr	315									N-Hydrochloride, 141, 139, N-Acetyl, 83, lgr

\*Derivative data given in order *m p*, crystal color, solvent from which crystallized

TABLE VIII. ORGANIC DERIVATIVES OF ETHERS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	$n_D^{20}$	$D_4^{20}$	Picrate	Sulfonamide	Nitro-derivative	Bromo-derivative	1,3,5-Tri nitro benzene addition compound	3,5 Dinitro benzoate	Miscellaneous
21	3-Nitroanisole	39	258		1.373 <sup>18</sup>							Reduct → <i>m</i> -Anisidine, (Picrate, 169d)
22	Isopropyl 2-naphthyl ether	40	285			95						
23	2-Naphthyl <i>n</i> -propyl ether	40	297			81						
24	Catechol diethyl ether (1,2-Diethoxybenzene)	43, dil al	217			69-71, red-br, unst in air	3,4- <i>di</i> 162 3, al	<i>tri</i> 122				
25	bz-Tetrahydro-6-methoxyquinoline	43	130	1.5718 <sup>50</sup>								
26	2,4,6-Trichlorophenetole	44	246					<i>di</i> 100				
27	8-Methoxyquinoline	45	175 <sup>29</sup>			162						
28	2-Aminodiphenyl ether	47	173 <sup>14</sup>									Acetate, 81
29	Pyrogallol trimethyl ether (1,2,3-Trimethoxybenzene)	47, dil al	241			78 5-80 0, yel	2,3,4- <i>tri</i> 123 4	5- <i>mono</i> 106, ac a	<i>mono</i> oil, <i>di</i> oil, 4,5,6- <i>tri</i> 73 4	81, pa yel		
30	4-Iodoanisole	52	139									
31	Phloroglucinol trimethyl ether (1,3,5-Trimethoxybenzene)	52 3, al	255 5 (cor)						2 <i>mono</i> 96 7, dil al, 2,4- <i>di</i> 129-30, al, 2, 4,6- <i>tri</i> 145, al			
32	Hydroquinone monomethyl ether	52 5	244 <sup>751 2</sup>									
33	4-Nitroanisole	54	274	1.5707 <sup>60</sup>	1.233 <sup>20</sup>							Reduct → <i>p</i> -Anisidine, 57
34	Hydroquinone dimethyl ether (1,4-Dimethoxybenzene)	56, 75% al	213 (cor)			47-8, or red, unst in air	148, al	2- <i>mono</i> 72, yel, 2,3- <i>di</i> 177, 2,5- <i>di</i> 202	<i>di</i> 142, ac a	<i>di</i> 86 5, red		
35	4-Methoxyaniline (4-Anisidine)	57	246		1.071 <sup>45</sup>							N-Formyl, 81, N-Acetyl, 130-2, w, N-Benzoyl, 216 7
36	4-Cyclohexylphenyl methyl ether	59	116 <sup>4</sup>									
37	2,4,6-Trichloroanisole	60						<i>di</i> 95				
38	1,3-Diphenoxypropane (Trimethylene glycol diphenyl ether)	61, al	338-40 (cor)				4,4'- <i>di</i> 245 55, al					
39	Catechol dibenzyl ether (1,2-Dibenzoyloxybenzene)	63 4, wh, me al						4- <i>mono</i> 98, pa yel, al				
40	1-Phenyl-2-phenoxy-methanol	64										<i>p</i> -Nitrobenzoate, 84
41	$\alpha$ -Glyceryl phenyl ether	70	187 <sup>15</sup>									
42	2,4,6-Tribromophenetole	72						79				

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VIII. ORGANIC DERIVATIVES OF ETHERS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	$n_D^{20}$	$D_4^{20}$	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	1,3,5-Tri-nitro-benzene addition compound	3,5-Dinitro-benzoate	Miscellaneous
43	Hydroquinone diethyl ether (1,4-Diethoxybenzene)	72						<i>mono</i> 49, yel, 2,3- <i>di</i> 130, yel, al, 2,5- <i>di</i> 176, yel, al		86.5		
44	Methyl 2-naphthyl ether (Nerolin)	73 (cor), eth	273			116.5-70, dk yel, 113.0-3.5	150.1, al	1- <i>mono</i> 128, 1,6,8- <i>tri</i> 215d	<i>x-mono</i> 62.3, pet eth, 1- <i>mono</i> 83-4, 3- <i>mono</i> 77.8, 6- <i>mono</i> 108	93.5, yel		
45	2,4,5-Tribromophenetol	73						79				
46	4-Ethoxybiphenyl (4-Biphenyl ethyl ether)	76, 74	188 <sup>13</sup>									
47	Benzyl 1-naphthyl ether	77 (cor)	200 <sup>12</sup>			85-100 (cor)						
48	2-Phenyl-2-phenoxy-ethanol	81										<i>p</i> -Nitrobenzoate, 87
49	4-Aminodiphenyl ether	83.5, 84, w	189 <sup>14</sup>									N-Acetyl, 127, N-HCl, 122
50	Biphenylene oxide (Dibenzofuran)	86, wh, al	288 (cor)			94		3- <i>mono</i> 181-2, <i>di</i> 245, ac a		96, yel		
51	4-Methoxybiphenyl (4-Biphenyl methyl ether, 4-Phenylanisole)	90, 89					3- <i>mono</i> 91.2, al, 3,5- <i>di</i> 137-8, yel, al, 3,4'- <i>di</i> 171	3- <i>mono</i> 79, 4'- <i>mono</i> 144, pet, 3,4'- <i>di</i> 134, 3,5- <i>di</i> 87, pet				
52	1,2-Diphenoxyethane (Ethylene glycol diphenyl ether)	98, al					4,4'- <i>di</i> 228-9, al	2',4'- <i>di</i> 215.2 (cor), pa yel, acet	<i>di-p</i> 134-5, al			
53	Benzyl 2-naphthyl ether (2-Benzyloxynaphthalene)	101.5 (cor), al	d			123.0 (cor)						
54	Anisoin (4,4-Dimethoxybenzoïn)	113										Methyl ether, 52-3, yel, CCl <sub>4</sub> , Ethyl ether, 103-4, al -w
55	Hydroquinone dibenzyl ether (1,4-Dibenzyl oxybenzene)	128-9, al						83				

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VIII. ORGANIC DERIVATIVES OF ETHERS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	$n_D^{25}$	$D_4^{20}$	Picrate	Sulfonamide	Nitro derivative	Bromo derivative	1,3,5-Trinitrobenzene addition compound	3,5-Dinitrobenzoate	Miscellaneous
56	<b>Ansil</b> (4,4'-Dimethoxybenzil)	133, yel										Monoxime, 133, <i>syn</i> -Dioxime, 217, <i>anti</i> -Dioxime, 195, bz, Disemicarbazone, 254 5, dil ac a, Dihydrazone, 118
57	<b>Antiarol</b> (5-Hydroxy-1,2,3-trimethoxybenzene)	148, w										Acetyl, 74, al, Methyl ether, 47, b p 271
58	<b>Anhalamine</b> (6,7-Dimethoxy-8-hydroxy-1,2,3,4-tetrahydroisoquinoline)	187-8, al				234-6						Dibenzoyl, 128-9, N-Benzoyl, 167 8
59	<b>7-Methoxyquinoline</b>	210	287 <sup>758</sup>			229						

\*Derivative data given in order m p, crystal color, solvent from which crystallized





## EXPLANATIONS AND REFERENCES TO TABLES IX AND X (Continued)

From the carbonyl compound in ethanol with 2,4-dinitrophenylhydrazine in 85% phosphoric acid

See Vogel, p 344, G D Johnson, *J Amer Chem Soc*, **73**, 5888 (1951), **75**, 2720 (1953)

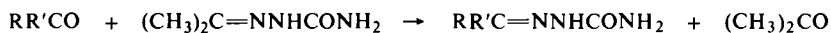
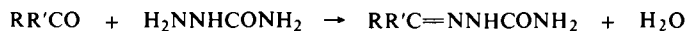
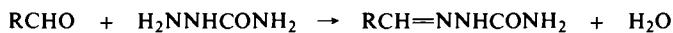
From the carbonyl compound with 2,4-dinitrophenylhydrazine and sulfuric acid in isopropyl alcohol

See N R Campbell, *Analyst*, **61**, 391 (1936)

From the carbonyl compound with 2,4-dinitrophenylhydrazine in pyridine

See E A Braude and C J Timmons, *J Chem Soc*, 3131 (1953)

### Semicarbazone \*



Semicarbazone

From the carbonyl compound with aqueous semicarbazide hydrochloride and sodium acetate

For directions and examples see Cheronis, pp 503-504, 512, Shriner, p 218, Vogel, p 344, Wild, p 121, A Michael, *J Amer Chem Soc*, **41**, 417 (1919)

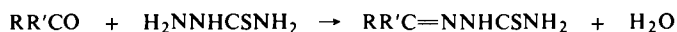
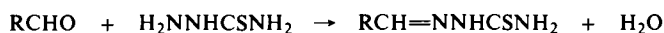
From the carbonyl compound in ethanol with aqueous semicarbazide hydrochloride and sodium acetate

See Linstead, p 27, Shriner, p 218, Wild, p 122, R L Shriner and T A Turner, *J Amer Chem Soc*, **52**, 1267 (1930)

From the carbonyl compound and acetone semicarbazone in acetic acid

See B Angla, *Ann Chim Anal Chim Appl*, **22**, 10 (1940)

### Thiosemicarbazone \*

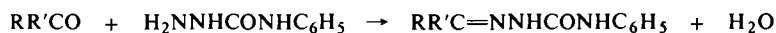
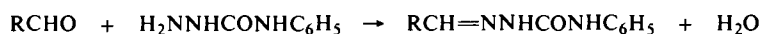


Thiosemicarbazone

From the carbonyl compound with thiosemicarbazide and sodium acetate in water, alcohol or acetic acid

For directions and examples see Cheronis, pp 503, 512, Wild, p 128, F J Wilson and R Burns, *J Chem Soc*, **121**, 873 (1922), W Baird, R Burns and F J Wilson, *J Chem Soc*, 2527 (1927), M Busch, *J prakt Chem*, **124**, 301 (1930), P P T Sah and T C Daniels, *Rec Trav Chim*, **69**, 1545 (1950)

### Phenylsemicarbazone \*

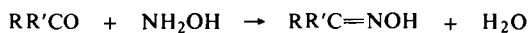
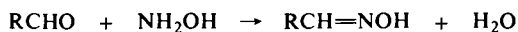


Phenylsemicarbazone

From the carbonyl compound with phenylsemicarbazide in alcohol or acetic acid

For directions and examples see P P T Sah and T-S Ma, *J Chinese Chem Soc*, **2**, 32 (1934), C A, **28**, 3713 (1934)

### Oxime \*



Oxime

From the carbonyl compound with hydroxylamine hydrochloride and pyridine in ethanol or without solvent

For directions and examples see Cheronis, p 513, Shriner, p 254, Vogel, p 345, J B Buck and W S Ide, *J Amer Chem Soc*, **53**, 1536 (1931), W E Bachmann and C H Boatner, *J Amer Chem Soc*, **58**, 2097 (1936), W E Bachmann and M X Barton, *J Org Chem*, **3**, 300 (1938)

For a modification of the above method in aqueous alcohol

See W M D Bryant and D M Smith, *J Amer Chem Soc*, **57**, 57 (1935)

From the carbonyl compound with hydroxylamine hydrochloride and sodium hydroxide in methanol or aqueous ethanol

### \*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLES IX AND X (Continued)

See: Cheronis, p. 513; Shriner, p. 255; Vogel, p. 721; Wild, p. 121.

From the carbonyl compound with hydroxylamine hydrochloride and potassium hydroxide in 95% ethanol.

See: Shriner, p. 255.

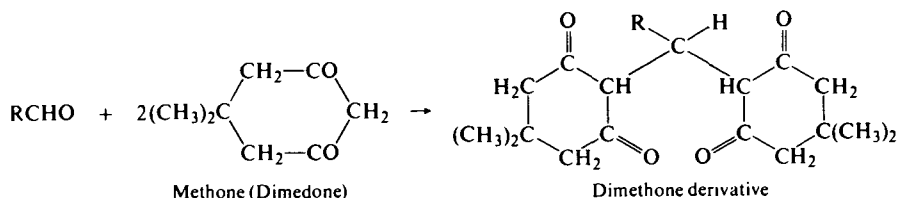
From the carbonyl compound with hydroxylamine hydrochloride and sodium or potassium acetate in water or aqueous ethanol.

See: Linstead, p. 27; Vogel, pp. 343, 345; J. S. Buck and W. S. Ide, *J. Amer. Chem. Soc.*, **53**, 1536 (1931).

From the carbonyl compound with hydroxylamine hydrochloride and sodium carbonate or bicarbonate in water or aqueous ethanol.

See: Wild, p. 120.

*Dimethone derivative (Methone derivative).\**



*This derivative is specific for aldehydes only.*

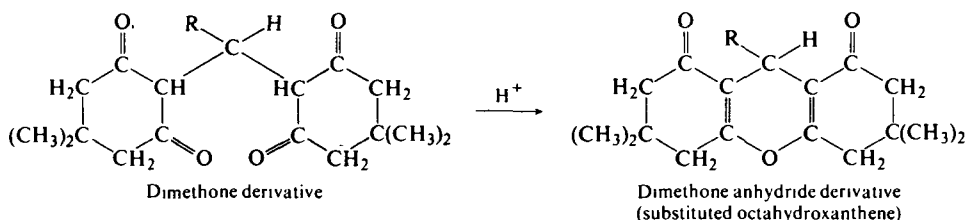
From the aldehyde and methone (dimedone; 5,5-dimethyl-1,3-cyclohexanedione; dimethyl dihydroresorcinol) in aqueous ethanol or methanol.

For directions and examples see: Cheronis, p. 505; Linstead, p. 27; Shriner, p. 220; Vogel, p. 333; Wild, pp. 136-7; D. Vorlander, *Z. Anal. Chem.*, **77**, 241 (1929); *Z. Angew. Chem.*, **42**, 46 (1929); W. Weinberger, *Ind. Eng. Chem., Anal. Ed.*, **3**, 365 (1931).

From the aldehyde with methone and a catalytic amount of piperidine in aqueous ethanol.

See: E. C. Horning and M. G. Horning, *J. Org. Chem.*, **11**, 95 (1946).

*Anhydride of dimethone derivative (substituted octahydroxanthene).\**



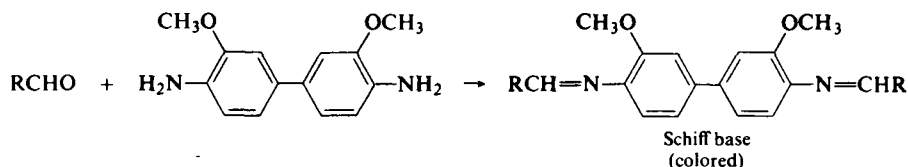
From the dimethone derivative with acetic anhydride.

For directions and examples see: Cheronis, p. 505; Vogel, p. 333.

From the dimethone derivative and a catalytic amount of hydrochloric acid in water or in ethanol.

See: Cheronis, p. 505; Linstead, p. 27; Shriner, p. 220; Vogel, p. 333; Wild, p. 137; E. C. Horning and M. G. Horning, *J. Org. Chem.*, **11**, 95 (1946).

*o-Dianisidine spot test.*



*This test is usually applicable to aldehydes only.*

From the aldehyde and a saturated solution of *o*-dianisidine (4,4'-diamino-3,3'-dimethoxybiphenyl) in glacial acetic acid.

For directions and examples see: F. Feigl, *Spot Tests in Organic Analysis*, 6th Ed., Elsevier Publishing Co., New York, 1960, p. 225; R. Wasicky and O. Frehden, *Mikrochim. Acta*, **1**, 55 (1927).

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**
**a) Liquids 1) Listed in order of increasing atmospheric b.p.\***

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	Semi-carbonyl	2,4-Di-nitro-phenyl-hydrazone	p-Nitro-phenyl-hydrazone	Phenyl-hydrazone	Oxime	Dimethyl one deriv (Dimedone deriv)	Dimethyl one anhydride	Miscellaneous	o-Dianisidine spot test		
													Cold	Hot	Limit γ
1	Formaldehyde (Methanal)	-21	-91		169	167, yel al	181 2, yel, bz	145	oil	189, al, 191 4			pa yel	or br	50
2	Trifluoroacetaldehyde	-20				151									
3	Acetaldehyde (Ethanal)	20 2	-123 5	1 3392 <sup>16</sup> , 1 3316	162 3	stable 168, al unstable 157, mixture 148	128 5	57, 99	47	139, al	175-6, al	Thio-semicarbazone, 146	or	dk br	30
4	Propionaldehyde (Propanal)	48 9	-81	1 364	89, bz-lgr, 154, w	148, or, 150, red, 155	125, yel, 50% al	oil	40	154 6, al	143	Picrate, 156-7	dk ol gn	red	20
5	Glyoxal	50	15		270	328	311	180	178	mono 186, di 228	mono 224	Phenyl-osazone, 169-70			
6	Acrolein (Acraldehyde)	52 4	-87 7	1 4025	171, w	165	150-1	50 1, hot lgr, pyrazoline		192, 50% al	163, al		red br	vlt br	0 1
7	Propynal (Propargyl aldehyde)	55										Cu deriv, 160			
8	2,2,2-Trifluoropropionaldehyde	56 <sup>745</sup>				151									
9	Isobutyraldehyde	64	-65 9	1 3730	125 6	187, or-yel, al, 182	130 1, or-yel, al	oil	oil	154	144				
10	2-Methyl-2-propenal (Methacrolein)	73 5		1 4191	198	206		74, pyrazoline							
11	n-Butyraldehyde (Butanal)	74 7	-97 1	1 38433	95 5, lgr, 106	123, al	87, yel, al, 93 5, red	93 5	b p 152 <sup>715</sup>	134, 142	141				
12	Trimethylacetaldehyde (Pivaldehyde)	75	3, 6	1 3791	190	210, yel			41						
13	Chloroacetaldehyde	85-6				134-5d, 148, al			oil						
14	2-Chloropropionaldehyde	86		1 431 <sup>17</sup>								Hydrate, b p 80 5-81			
15	Dichloroacetaldehyde	89 5-90 5				155-6, using only 1 equivalent of reagent			b p 67-9 <sup>17</sup> , using only 1 equivalent of reagent						

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

a) Liquids 1) Listed in order of increasing atmospheric b.p.\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	Semi-carbazone	2,4-Di-nitro-phenyl-hydrazone	p-Nitro-phenyl-hydrazone	Phenyl-hydrazone	Oxime	Dimeth-one deriv (Dime done deriv)	Dimeth one anhy dride	Miscel-laneous	α-Diansidine spot test				
													Cold	Hot	Limit, γ		
16	Methoxyacetaldehyde	92		1.3950		124.5	115										
17	3-Methylbutanal (Isovaleraldehyde)	92.5	-51	1.39225	107	123, yel - or, al	110.1, al	oil	48.5	154-5, al	173 (cor)	Thio-semicarbazone, 52.3					
18	2-Methyl-1-butanal (α-Methylbutyraldehyde)	92-3	20, tri-	1.3942	103.5, bz - pet eth	120											
19	Trichloroethanal (Chloral, Trichloroacetaldehyde)	98	-57.5	1.45572	90d	131	131, yel		56			Hydrate, 51.7					
20	Pentanal (Valeraldehyde)	103.4	-91.5	1.3947		98, yel, al, 107			52, pet eth	104.5	113	Thio-semicarbazone, 65					
21	tert-Butylacetaldehyde	103		1.4150		147											
22	2-Butenal (Crotonaldehyde)	104	-69	1.4362 <sup>20.5</sup>	199	190, crim, bz - lt pet	184.5	56	119	183	163, sint, 167	Phenyl-semicarbazone, 126-7	dk red	dk br - red		2	
23	Dimethylethylacetaldehyde	104															
24	Ethoxyacetaldehyde	106		1.3956		116.7, me al	113.4, al										
25	2-Isopropylacrolein	107.9		1.4223		165											
26	2-Butynal	105		1.446 <sup>19</sup>		136											
27	Methylisopropylacetaldehyde	114		1.3998 <sup>25</sup>		124											
28	2-Bromoisobutyraldehyde	115		1.4518 <sup>25</sup>									Decomposes in w				
29	Diethylacetaldehyde (2-Ethylbutyraldehyde)	116-117		1.4025	99, bz - lt pet	95, pa - or, lt pet, 129, 30, al				102, me al							
30	Methyl-n-propylacetaldehyde	116 <sup>737</sup>			102	103											
31	2-Methyl-2-butenal	116.9			216												
32	n-Propoxyacetaldehyde	119 <sup>748</sup>				86											
33	Isobutylacetaldehyde (Isocaproaldehyde)	121 <sup>743</sup>			127	99			b p 103 <sup>35</sup>								
34	Paraldehyde (Acetaldehyde trimer)	124.4 <sup>752</sup>	12.6	1.4049								Dilute acid → Acetaldehyde, b p 20.2	dk ol grn	dk red br		4	
35	2-Pentenal	125			180		123										
36	3-Methoxyisobutyraldehyde	129		1.4030 <sup>27</sup>		102											

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
**a) Liquids 1) Listed in order of increasing atmospheric b.p.\* (Continued)**

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	Semi carbazone	2,4-Di nitro phenyl hydrazone	p Nitro phenyl hydrazone	Phenyl hydrazone	Oxime	Dimeth one deriv (Dime done deriv)	Dimeth one anhy dride	Miscel laneous	o-Dianisidine spot test		
													Cold	Hot	Limit γ
37	3-Chloropropionaldehyde	130-1		1.475 <sup>15</sup>								Trimer 35.5, dil HCl-abs al b p 170.5 <sup>12-5</sup>			
38	Hexanal (Caproaldehyde)	131		1.4068	106, bz-pet eth	104, or-yel			51, pet eth me al	108.5, dil al		Phenyl-semicarbazone, 135-6			
39	Ethylisopropylacetaldehyde	133.5		1.4086 <sup>25</sup>		121									
40	3,3-Dimethylpentanal	134		1.4292		102									
41	3-Methyl-2-butenal (3-Methylcrotonaldehyde)	135		1.4526	223	182									
42	Cyclopentanecarboxaldehyde	136			124										
43	2-Methylpenten-2-al-1 (3-Ethyl-2-methylacrolein)	136.8		1.4488	207	159, red al		58-60	48-48.8						
44	Tetrahydrofurfural	142-3 <sup>79</sup>		1.4473 1.43658	166	134						Conc HCl → brt red col α Benzyl-α phenyl hydrazone 67 me al			
45	5-Methylhexanal	144 <sup>750</sup>		1.4114	117	117									
46	3-Furaldehyde	144 <sup>732</sup>		1.4945	211			149.5							
47	1-Cyclopentenylformaldehyde	146		1.4828 <sup>21</sup>	208										
49	2-Chloro-2-butenal (2-Chlorocrotonaldehyde)	147-50		1.478 <sup>23</sup>								Cyano-hydrin b p 137.8 <sup>28</sup> , n <sub>D</sub> <sup>20</sup> 1.4762			
50	2-Hexenal	150		1.4470 <sup>13</sup>	176										
51	3-Hexenal	150			147										
52	Heptanal (Enanthaldehyde)	155	-45	1.4125	109, al	108, yel, al	73		57	135	112		red-br	red	9
53	Ethylisobutylacetaldehyde	155			98										
54	Dl-n-propylacetaldehyde	161		1.4142 <sup>15</sup>	101				b p 126 <sup>47</sup>						

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**
**a) Liquids 1) Listed in order of increasing atmospheric b.p.\* (Continued)**

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	Semicarbazone	2,4-Dinitrophenylhydrazone	p Nitrophenylhydrazone	Phenylhydrazone	Oxime	Dimeth one deriv (Dime done deriv)	Dimeth one anhydride	Miscellaneous	o-Dianisidine spot test		
													Cold	Hot	Limit, γ
55	2-Furancarboxaldehyde (Furfural)	161.7	-36.5	1.52608	202	212.4, yel., 230 (cor), red, mixture 185	54	97	α 75-6, pet eth, β 91.2, al	160d	162.5	Phenylsemicarbazone, 180.1	dk red-vlt	dk bl-vlt	0.02
56	Hexahydrobenzaldehyde	162		1.4495 <sup>19</sup>	173, 176, w	172			90-1, pet eth			Oxime-HCl, 107-8d			
57	2-Ethylhexanal-1 (n-Butylethylacetaldehyde)	163		1.4150	254d	114.5, dil al, 120.1, yel, al									
58	2,2,3-Trichloro-n-butyraldehyde (n-Butylchloral, Crotonchloral)	164.5 5.5		1.47554					65			NH <sub>3</sub> → Butylchloral ammonia, 62			
59	Butanedial (Succinaldehyde)	169-70d		1.4254		280			di 172			Polymer, 65			
60	Octanal (n-Octaldehyde Caprylaldehyde)	171		1.42167	98, dil me al 101	106, yel, al, 96	80, brt yel		60, me al	90, dil al	101	Thiosemicarbazone, 94-94.5			
61	2-Ethyl-3-n-propylacrolein	173		1.4518 <sup>22</sup>	150.1, 153	124.5, 122									
62	3-Fluorobenzaldehyde	173					202	114	63						
63	2,2,2-Tribromoethanal (Bromal)	174, yel							115			Mono-hydrate, 53.5	no reac	dk grn	40
64	4-Fluorobenzaldehyde	174.5 <sup>52</sup>					212	147	syn 116.7, anti 86						
65	2-Fluorobenzaldehyde	175	-44.5				205	90	63						
66	Benzaldehyde	179	-26, fp -55.6	1.5446	222, 233-5, r htng	237, or, al	190, red, al 234, 6, 262	158, 154.5	α 35 (stable) β 130, eth 64, pet eth	193	200	Phenylsemicarbazone, 180.1	or	red-or	3
67	Nonanal (Pelargonaldehyde)	185		1.4273	100.84, me al	100 (cor), yel, al						Phenylsemicarbazone, 131.2			
68	5-Methylfurfural	187		1.5147 <sup>25</sup>	211*	212 (cor)	130, red	147-8	syn 112, anti 51-2						
69	Glutaraldehyde	187-9d		1.4330 <sup>25</sup>			169		di 175, 178, w						
70	Phenylethanal (Phenylacetaldehyde)	194	33	1.53191	153, dil al, 156	121, grn-yel, al, 110		58, lgr, 62-3	97-8, eth, 100	165	126		dk br-red	dk br	polym

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

a) Liquids 1) Listed in order of increasing atmospheric b.p.\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	Semi carb zone	2,4-Di nitro phenyl hydrazone	p Nitro phenyl hydrazone	Phenyl hydrazone	Oxime	Dimeth-one deriv (Dime done deriv)	Dimeth one anhy dride	Miscel-laneous	o-Diamidine spot test		
													Cold	Hot	Limit, γ
71	2-Hydroxybenzaldehyde (Salicylaldehyde)	197 (cor)	-7, f p 16	1.574	231	248, red, abs al 252d, lt red, ac a 242	227, red-br, al	142	57, 63		208, 70% al	p-Nitrobenzoate, 128	or	or	5
72	2-Thiophenecarboxaldehyde	198		1.5950 <sup>16</sup>				119 139							
73	3-Methylbenzaldehyde (3-Tolu-aldehyde)	199		1.5413 <sup>21</sup>	204 223 4	212, 194	157	91, lgr, 84	60, lgr	172	206		dk or-red	ch red	5
74	2-Methylbenzaldehyde (2-Tolu-aldehyde)	200		1.5481	209 al, 212, 218	193 4, red, ac a	222, red, al	101, 105 6, 111	49	167	215		dk or-red	ch red	5
75	4-Methylbenzaldehyde (4-Tolu-aldehyde)	204 5		1.5454	234, al, 215	232 5 4 5 (cor) or-yel al PhNO <sub>2</sub>	200 5 (cor), dk red, ac a	112-3, al, 121	79-80, 110				dk or-red	ch red	5
76	d-Citronellal (d-Rhodinal)	207		1.4485	83-4, chl, ppt by lgr 91 2	78, yel, al			oil	77 9, dil al	173		dk grn	brt red	10
77	Decanal (Capraldehyde)	207-9		1.4287	102	104, yel			69, dil me al	91 7, dil al		Thio-semicarbazone, 99-100	pa ol	dk br	200
78	2-Chlorobenzaldehyde	213-4	11	1.56708	146, yel, 225, pyr, 229-30, me al	213 6 (cor), 209, or red, xyl	237 8, red, al, 241, br-red, 249, or	86	α 75-6, al, β 101 3	205d, al	224 6 (cor), al				
79	Phenoxyethanal (Phenoxyacetaldehyde, Glycolaldehyde phenyl ether)	215d		1.5380 <sup>21</sup>	145			86, pa yel, al	95, pet eth						
80	3,5-Dimethylbenzaldehyde	220-2	9	1.5385	201 2							Oxid → acid, 170, al			
81	3-Phenylpropionaldehyde (Hydrocinnamaldehyde)	224			127, al	149, yel, al	122 3, yel, dil al		93-4 5, dil al 97 (cor)						
82	Citral a. (Geranial)	228d		1.48752	164, me al	108-10, red-or al, 116			143 5				dk red	red blk	0 1
83	Citral b. (Neral)	228d		1.4900	HCl 171, mixture 132, NaOAc	96, red-or, al							dk red	red blk	0 1

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES  
a) Liquids 1) Listed in order of increasing atmospheric b.p.\* (Continued)

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	Semi carbazone	2,4-Di-nitro-phenyl-hydrazone	p-Nitro-phenyl-hydrazone	Phenyl-hydrazone	Oxime	Dimeth-one deriv (Dime-done deriv)	Dimeth-one anhy-dride	Miscel-laneous	o-Dianisidine spot test				
													Cold	Hot	Limit γ		
84	2,6-Dimethylbenzaldehyde	228 <sup>742</sup>	11		158												
85	3-Methoxybenzaldehyde (3-Anisaldehyde)	230	3-4	1.5538	233d		171	76	39-40 pet eth., 112			Phenylthio-semicarbazone, 153	dk or	red br	0.4		
86	3-Bromobenzaldehyde	234-6			205		220	141	72								
87	4-Isopropylbenzaldehyde (Cumaldehyde)	236		1.5301	211, me al	241, red bz., 243, red, ac a., 244.5, al-chl	190, al	129, al	α 52, al β 111	170-1, al	172-3		dk red	ol yel	3		
88	3-Ethoxybenzaldehyde	245-5		1.5408													
89	4-Methoxybenzaldehyde (4-Anisaldehyde)	248	2-5	1.5731	210, 203	253.4d, red, ac a., 250, red, xyl	160, red-vlt	120.1, wh, dil al	α' 64-5, bz α 4-5 (from α' on fusion) β 133, bz	144.5 (cor), al	243 (cor), al		dk or	red br	0.4		
90	3-Phenylpropenal (Cinnamaldehyde)	252d	-7.5	1.61949	215.6 w	255d, red, ac a	195, red, al	168, yel, dil al	α 64-5, lgr, β 138.5, bz	213 (cor), al	175, al		dk ch red	ch red	0.05		
91	4-Ethoxybenzaldehyde	255, 249	13-4		202d, al, 208				syn 157 anti 118								
92	3,4-Diethoxybenzaldehyde (Protocatechualdehyde diethyl ether)	277-80							98			Oxid → acid, 165					
93	Diphenylacetaldehyde	315-6d			162				α 120, β 106			Oxid → Benzophenone 48					

\*Derivative data given in order m.p., crystal color, solvent from which crystallized



**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
**a) Liquids 2) Reduced pressure b.p. only (listed in order of increasing semicarbazone m.p.)\***

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	Semi carba zone	2,4-Di nitro phenyl hydra zone	p Nitro phenyl hydra zone	Phenyl hydra zone	Oxime	Di meth one deriv (Dime done deriv)	Di meth one anhy dride	Miscellaneous	o-Dianisidine spot test				
													Cold	Hot	Limit γ		
1	7-Methyloctanal	94 <sup>120</sup>			80	100											
2	3-(2-Furyl)propionaldehyde	70 <sup>14</sup>		1.4470	80												
3	2-Methyloctanal	83 <sup>20</sup>			80												
4	2,3-Dichloro-n-butyr-aldehyde	58 60 <sup>20</sup>		1.4618 <sup>21</sup>	96.7				oil								
5	Octanal (n-Octaldehyde)	81 <sup>32</sup>		1.4217	98.101	106 yel	80		59.60	89.8							
6	Undecanal (Hendecanal)	120 <sup>20</sup>	-4	1.4324 <sup>23</sup>	103 me al	104 yel			72 wh me al			Timer 47.8					
7	Tridecanal (n-Tridecylaldehyde)	136 <sup>8</sup>	15		106 al	108			80.5 dil al			Trimer 61.5 eth					
8	2-Hydroxypropionaldehyde	114 <sup>9</sup>			114 w		127										
9	2-n-Amylcinnamaldehyde (2-n-Pentylcinnamaldehyde Jasminaldehyde)	161 3 <sup>17</sup>		1.5381	118	164 red al			74 al w								
10	2-Methyl-3-phenylpropionaldehyde	90 <sup>8</sup>			123												
11	2-Hydroxy-2-methylhexanal (n-Butylmethylglycolaldehyde)	87.8 <sup>3</sup>			143												
12	Phenoxyacetaldehyde	83		1.5360	146	138			95								
13	2-Ethyl-2-hexenal	73 <sup>20</sup>			152	125											
14	2-Ethyl-3-hexenal	84 <sup>32</sup>			156												
15	Cyclohexylacetaldehyde	58 <sup>10</sup>		1.4509 <sup>25</sup>	159	125											
16	2-Nonenal	126 <sup>21</sup>		1.4426	165	126	113										
17	2-Heptenal	85 <sup>14</sup>		1.4314	169		116										
18	2,3,6-Trimethylbenzaldehyde	114 <sup>10</sup>			169				126								
19	3,5-Dimethylhexahydrobenzaldehyde	71 <sup>11</sup>			171												
20	2-Hydroxy-2-phenylpropionaldehyde (Methylphenylglycolaldehyde)	101 <sup>4</sup>			182.3												
21	2,4,6-Trimethylbenzaldehyde	98 <sup>6</sup> 128 <sup>15</sup>		1.5524	188												
22	2-Hydroxy-2-phenylbutyraldehyde (Ethylphenylglycolaldehyde)	110 11			188												
23	2-Hydroxybutyraldehyde (Aldol)	83 <sup>2</sup>			194		109.11 red yel dil al		syn 112 anti 51.2	146.8 30 <sup>o</sup> me al	126	4-Bromo phenylhy drazone 127.8					
24	1,2,3,4-Tetrahydro-2-naphthaldehyde	92 <sup>1</sup>			197												
25	2-(1-Naphthyl)propionaldehyde	132 <sup>2</sup>			204												

\* Derivative data given in order: m.p. crystal color solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

a) Liquids 2) Reduced pressure b.p. only (listed in order of increasing semicarbazone m.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	Semi carba zone	2,4-Di nitro phenyl hydra zone	p Nitro phenyl hydra zone	Phenyl hydra zone	Oxime	Di meth one deriv (Dime done deriv)	Di meth one anhy dride	Miscellaneous	o-Dianisidine spot test			
													Cold	Hot	Limit γ	
26	1,6-Hexanedial (Adipic dialdehyde)	94 <sup>12</sup> , 70 <sup>5</sup>		1.4350	di 206				di 185.6 w							
27	2-Methylcinnamaldehyde	124 <sup>14</sup>		1.6057 <sup>17</sup>	208, al - w											
28	Phenylglyoxal	108 <sup>15</sup>			mono 208 9d yel al bis 229d		309					91 (mono hyd) w 2 Thio semicarba zone, 170 yel al				
30	Cyclohexenecarboxaldehyde	70 <sup>11</sup>		1.4921 <sup>1</sup>	213				99							
31	2-Phenoxybenzaldehyde	153 <sup>1</sup>			215											

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
**a) Liquids 3) Miscellaneous; reduced pressure b.p. only (listed alphabetically)\***

No	Name	Boiling point °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	Semi carbazone	2,4 Di nitro phenyl hydrazone	p-Nitro phenyl hydrazone	Phenyl hydrazone	Oxime	Di meth one deriv (Dime done deriv )	Di meth one anhy dride	Miscellaneous	o Diamisidine spot test		
													Cold	Hot	Limit γ
1	2-Chloroacrolein	29 31 <sup>17</sup>		1.463								Diethylacetal, b p 158-60			
2	4-Chloro- <i>n</i> -butyraldehyde	50 <sup>11</sup>		1.44662 <sup>25</sup>		134.5	110		74.5						
3	<i>d,l</i> -2,3-Dichloropropionaldehyde	48 <sup>14</sup>		1.4762								Dimethylacetal, b p 78-82 <sup>13</sup> , n <sub>D</sub> <sup>18</sup> 1.144			
4	2-Heptynal	54 <sup>13</sup>		1.4521 <sup>17</sup>		74									
5	2,4-Hexadienal (Sorbalddehyde)	65 <sup>11</sup>		1.5372 <sup>22</sup>				102	160						
6	4-Hydroxy- <i>n</i> -butyraldehyde	68 <sup>8</sup>		1.4403		118									
7	3-Hydroxy-2-isopropylpropionaldehyde	84 <sup>10</sup>				126									
8	3-Hydroxy-3-methyl- <i>n</i> -butyraldehyde	67 <sup>13</sup>					142								
9	4-Methoxy-2-methyl- <i>n</i> -butyraldehyde	66 <sup>55</sup>		1.4280 <sup>25</sup>		88									
10	5-Methyl-2-thiophene-carboxaldehyde	114 <sup>25</sup>		1.5782 <sup>29</sup>				126							
11	3-Methyl-2-thiophene-carboxyaldehyde	114 <sup>25</sup>		1.5833 <sup>25</sup>				149							
12	4-Octenal	84 <sup>13</sup>		1.4463 <sup>25</sup>		108									
13	Phenylpropargyl aldehyde	116 7 <sup>17</sup>		1.6032 <sup>25</sup>					108, lgr						
14	2-Phenylpropionaldehyde	76 <sup>4</sup>				135									
15	3-Pyridinecarboxaldehyde (Nicotinaldehyde)	99 <sup>26</sup>						158							
16	2,2,4-Trichloro- <i>n</i> -butyraldehyde		f p -78									HNO <sub>3</sub> → acid, 73.5			
17	2,4,6-Trihydroxybenzaldehyde (Phloroglucinaldehyde)		d						195d, (hyd), w			2,4,6 Triacetate 156.7, al 2- Benzoate 198 200, chl			
18	4-Vinylbenzaldehyde (4-Formylstyrene)	93 <sup>14</sup>		1.5960 <sup>25</sup>				131							

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point °C	Boiling point °C	Semi carbazone	2,4-Di-nitro phenyl hydrazone	p Nitro phenyl-hydrazone	Phenyl hydrazone	Oxime	Dimeth one deriv (Dime done deriv)	Di meth one anhy dride	Miscellaneous	o Dianisidine spot test		
												Cold	Hot	Limit γ
1	3-Chlorobenzaldehyde	17 8	213 4	228, pyr 230, me al	248, dk red, xyl, 256, or-yel	216, dil al	134 5, abs al	α, anti 70 1, al β, syn 118 125			n <sub>D</sub> <sup>20</sup> 1 55908			
2	2,3,5,6-Tetramethylbenzaldehyde	20	135 <sup>11</sup>	270d										
3	2-Ethoxybenzaldehyde (Salicylaldehyde ethyl ether)	20 2 6-7	247 9	219, al				57 9, pet eth			Diacetate 88 9, ac anhy			
4	Tetradecanal (Myristaldehyde)	23 3 5	166 <sup>24</sup>	106 5, dil al	108	95 brt yel		82 5 3 5, dil al			Trimer, 65			
5	Pentadecanal	24 5	160 <sup>14</sup>	106 5, al	106 7, yel, pyr-al	94 5, yel, al		86, dil al			Trimer, 69 70			
6	Hexadecanal (Palmitaldehyde)	34		107, dil al, 108-9	108	96 5, yel, eth		88, yel			Trimer, 73 Thiosemicarbazone, 106 9			
7	1-Naphthaldehyde	34	292 162 <sup>18</sup>	221		224	80	98 90						
8	Phenylacetaldehyde	34	195	156, 163	121	151	mono 63, 58, di 101-2 113	99, 103	165					
9	4-Methoxy-1-naphthaldehyde	34, wh	200 <sup>11</sup>								Azine 185, yel, al			
10	(5-Hydroxymethyl) furfural	35 6	115 20 <sup>9</sup>	195d al, recr tol - lgr	184 red	185 dk red, al	140 1, tol	77 8, 108						
11	Heptadecanal (Margic aldehyde)	35-6, 63						89 5, et ac			Trimer, 77-8, lit pet			
12	3,4-Methylenedioxybenzaldehyde (Piperonal)	37	263	230, 234, 237	265d, xyl, 266d, red, ac a	199 200, red	102 3, yel, al, 99, 106 79	146, me al, anti 112, w 108 89	177 8, 193, yel, al	220 (cor)		brt red	dk red	4
13	2-Iodobenzaldehyde	37	129 <sup>14</sup>	206										
14	Octadecanal (Stearaldehyde)	38		108-9	101, 110	101, yel, me al					Thiosemicarbazone, 111			
15	2-Methoxybenzaldehyde (o-Anisaldehyde, Salicylaldehyde methyl ether)	38-9	243-6 (cor)	215d, al	253 5 (cor), red, xyl	204-5, br red		92, dil al			n <sub>D</sub> <sup>20</sup> 1 5598			
16	2-Aminobenzaldehyde	40				220	221	135 93						
17	4-Diethylaminobenzaldehyde	41	172 <sup>7</sup>	241d, al			103, yel-br							
18	Dodecanal (Lauraldehyde)	2 forms a) 42-3 b) 11	238	103, 106	106, yel	96		76-7, eth, 77-8, me al			Thiosemicarbazone, 100			

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	Semi-carbazone	2,4-Dinitrophenylhydrazone	p-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Dimethone deriv (Dime done deriv)	Dimethone anhydride	Miscellaneous	o-Dianisidine spot test		
												Cold	Hot	Limit, γ
19	3,4-Dichlorobenzaldehyde	43.4	247.8			276.7, or		syn 120 al, on fusing → anti 114.5 118-9						
20	3-Phenylcinnamaldehyde	44	210 <sup>14</sup>	214.5	196		173, yel							
21	2,4,5-Trimethylbenzaldehyde	44	120 <sup>10</sup>	243			127							
22	2-Nitrobenzaldehyde	44		256	265	263	156	anti 102 syn 154, bz 94.5, lgr				grn br	red br	5
23	3,4-Dimethoxybenzaldehyde (Veratraldehyde)	44, 58	285	177	261.3 (cor), or, PhNO <sub>2</sub> , 264.5		121, al		173					
24	4-Chlorobenzaldehyde	48	214.5 6.5	230, pyr 233, me al	254 (cor), or	237, dk br, al	127 7.5, lt yel, dil al	α 110, β 146						
25	2-Pyrrolicarboxaldehyde	50	217.9	183.5, w		182.3, red, xyl	139, lgr	164, bz			n <sup>b</sup> 15939			
26	Benzylglycolaldehyde	52	121 <sup>4</sup>	137							Benzoate, 70			
27	Furfural diacetate	52, eth	220											
28	4-Chloro-2-hydroxybenzaldehyde	52.5		212 pa yel, ac a		257, or, ac a		155, col, al						
29	Quinoline-4-carboxaldehyde	51.3, tol (anh), 84.4.5 (monohyd)	123 <sup>4</sup>			261.2 yel al		181.2 me al			Picrate, 179			
30	2-Ethyl-4-hydroxybenzaldehyde	53	145 <sup>1</sup>											
31	2-(2-Furyl)acrolein	54, lgr	95 <sup>9</sup>	219.5			132, pet eth 138	110.1						
32	2,3-Dimethoxybenzaldehyde (o-Veratraldehyde)	54	137 <sup>12</sup>	231d				99, al-w						
33	9-Hydroxynonanal	54	120 <sup>9</sup> 1											
34	2,3-Diphenylpropionaldehyde	54	170 <sup>11</sup>	125										
35	3-Benzoyloxybenzaldehyde	54	218 <sup>20</sup>											

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point °C	Semi-carbazon	2,4-Dinitrophenylhydrazone	p-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Dimethone deriv (Dime-done deriv)	Dimethone anhydride	Miscellaneous	o-Dianisidine spot test		
												Cold	Hot	Limit, γ
36	3-Chloro-2-hydroxybenzaldehyde (3-Chlorosalicylaldehyde)	54.5		240-3, 50% ac a				167-8, dil al			5 Nitro deriv, 129, yel, dil al			
37	Octatrienal	55												
38	Isoquinoline-1-carboxaldehyde	55.5		197			171.2							
39	Phthalaldehyde	56					191					brt yel ppt	brt yel ppt	
40	2,3,5-Trichlorobenzaldehyde	56 col, dil al									Oxid $\xrightarrow{\text{KMnO}_4}$ acid, 162.3 Diacetate, 94, al			
41	2-Hydroxy-5-methylbenzaldehyde (5-Methylsalicylaldehyde)	56 dil al	217.8				149 yel, al	105, w						
42	3-Iodobenzaldehyde	57		226		212	155	62						
43	4-Bromobenzaldehyde	57		228, 229	128, 257	207.8	113	syn 157, anti 111						
44	3-Nitrobenzaldehyde	58		246	293d	247	120, 124	120, 122						
45	2,5-Dichlorobenzaldehyde	58	231-3				104-5, al	127.5-8, dil al						
46	2,4,6-Trichlorobenzaldehyde	58-9												
47	2-Phenanthraldehyde	59, 59.5		282				175						
48	Para-isobutyraldehyde (2,4,6-Tri-isopropyl-1,3,5-trioxan)	59, 60	195 (cor), sl depolym								See Isobutyraldehyde b p 64			
49	1-Hydroxy-2-naphthaldehyde	59, 60, gm - yel, al - w						145, bz						
50	2-Naphthaldehyde	60, w	150 <sup>15</sup>	245, al	270	230	205.6 d, al, 217.8	156, dil al						
51	4-Phenylbenzaldehyde	60		243d, al	239d, scar, xyl		189d	149-50						
52	3-Methoxy-1-naphthaldehyde	60, pet eth		200, al - w		197, red, ac a		102, al - w						
53	4-Ethoxy-3-methoxybenzaldehyde	64												
54	3,5-Dichlorobenzaldehyde	65	235 40 <sup>748</sup>				106.5, yel, pet eth	112						
55	2,3-Dichlorobenzaldehyde	65.7												
56	5-Methoxy-1-naphthaldehyde	66, yel, pet eth		246, ac a - w		246, red, ac a - w		104, w						

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semi-carbazine	2,4-Dinitrophenylhydrazone	p-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Dimethone deriv (Dime-done deriv)	Dimethone anhydride	Miscellaneous	o-Dianisidine spot test			
												Cold	Hot	Limit, γ	
57	Dibenzofuran-2-carboxaldehyde	68					162								
58	2,6-Dichlorobenzaldehyde	70-1									o-Nitrophenylhydrazone, 154, p-Bromophenylhydrazone, 142				
59	2,4-Dimethoxybenzaldehyde (β-Resorcylaldehyde dimethyl ether)	71, dil al, 69	165 <sup>10</sup>					106, w			5-Nitro deriv 188 9, me al				
60	Quinoline-2-carboxaldehyde	71, pet eth (anh), 51 (monohyd), w				250, yel, 225, subl	204, yel, al	188							
61	4-Ethoxy-1-naphthaldehyde	72									Hydrazone, 160 182, dk red, Azine, 209, yel, PhNO <sub>2</sub>				
62	4-Aminobenzaldehyde	72		153			156	124				or br	red br	0.4	
63	2,4-Dichlorobenzaldehyde	72, 74 5						136 7			Oxime HCl, 133 5				
64	4-Dimethylaminobenzaldehyde	74		222	325	182	148	185							
65	4-Methylthiazole-5-carboxaldehyde	75, 72 5	118 <sup>21</sup>					159, 161							
66	Quinoline-6-carboxaldehyde	75 6 (anh), 55 (hyd)		239, yel, al				185, red, al	191, yel, al		Methiodide, 218, yel, al				
67	3,4,5-Trimethoxybenzaldehyde (Gallaldehyde trimethyl ether)	78, 75	163-5 <sup>10</sup>	219-20		201-2		83 4							
68	4-Iodobenzaldehyde	78		224	257	201	121								
69	3-Phenanthraldehyde	80		275				145							
70	4-Hydroxy-3-methoxybenzaldehyde (Vanillin)	80 1, w	285d	230, 240d.	271d (cor), red, ac ac, 268	227, ac a, 223	105, bz	117, w, 122	196-8 (cor), al	228	2,4-Dinitrophenyl ether, 131	brt or red	ch red	3	
71	2-Hydroxy-1-naphthaldehyde	82, al	192 <sup>27</sup>	240, yel, me al				157			Picrate, 120	or	brk red	10	
72	Stilbene-2-carboxaldehyde	83													
73	2-Methoxy-1-naphthaldehyde	84, al	200-1 <sup>11</sup>								Azine, 255-6, yel, PhNO <sub>2</sub>				

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point °C	Semi-carbazine	2,4-Dinitrophenylhydrazine	p-Nitrophenylhydrazine	Phenylhydrazine	Oxime	Dimeth-one deriv (Dime-done deriv )	Di meth-one anhy-dride	Miscellaneous	o-Dianisidine spot test		
												Cold	Hot	Limit, γ
74	2,3,6-Trichlorobenzaldehyde	86.7									Ac anh + ac a + NaOAc → 2,3,6-trichlorocinnamic acid, 189. ac a			
75	Isophthalaldehyde	89					242	180						
76	3,4,5-Trichlorobenzaldehyde	90 l, al		252-4, al		342d, or, PhNO <sub>2</sub>	147				2-Nitro deriv, 118.5.9.0 Oxid alk KMnO <sub>4</sub> → 3,4,5-trichlorobenzoic acid, 210			
77	Phenylglyoxal hydrate	91		α 217d		309	di 152	α 129, di 168						
78	2,3,4-Trichlorobenzaldehyde	91									Ac anh + ac a + NaOAc → 2,3,4-trichlorocinnamic acid, 185			
79	Quinoline-8-carboxaldehyde	94.5, dil al		238.9, bz			176, yel, al	115, dil al						
80	2-Phenylcinnamaldehyde	94, al, 95	195, 200 <sup>1</sup>	188-9, al, 195			125.6, yel, ac a, 141	165-6, al						
81	3,5-Dichloro-2-hydroxybenzaldehyde (3,5-Dichlorosalicylaldehyde)	95.6		227d, ac a			153, pa yel, al	195-6, al-w (4.1)			Ac anh + ac a + NaOAc → dichlorocoumarin, 160, bz			
82	Hydroxyacetaldehyde (Glycolaldehyde)	96.7					162				Phenylosazone, 178.9, yel, eth, p-Nitrophenylosazone, 311			
83	3-Chloro-n-butyraldehyde (Trimer)	96.7	28-33 <sup>13</sup>											
84	2,2-Dimethyl-3-hydroxypropionaldehyde	97	85 <sup>15</sup>											
85	2,3,4,6-Tetrachlorobenzaldehyde	97.8												
86	Benzaldehyde-2-carboxylic acid (2-Formylbenzoic acid, Phthalaldehydic acid)	98.9 (hyd), 240-50 (anh)		202				120, w						
87	3-Hydroxy-2-naphthaldehyde	99-100		>270, me al			246-8	207d						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized



TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	Semi carbazone	2,4-Di-nitro-phenyl-hydrazone	p-Nitro-phenyl-hydrazone	Phenyl-hydrazone	Oxime	Dimeth-one deriv (Dime-done deriv)	Di meth one anhy dride	Miscellaneous	o Diamidone spot test			
												Cold	Hot	Limit, γ	
88	5-Chloro-2-hydroxybenzaldehyde	99 100	105 <sup>12</sup>	286-7, ac a			150 2	128 w 123 4							
89	9-Phenanthraldehyde	101		223		265		157							
90	3-Hydroxybenzaldehyde	104 108 (cor.), w	240	198, 199	259, scar, xyl 260d, red, al	221 2, dil ac a	130 1 5, tol, 147, recr bz	90, 88				dk br red	dk ch red	4	
91	9-Anthraldehyde	105		219, yel, al			207, or, al	187							
92	4-Nitrobenzaldehyde	106		221, 211	320	249	159, 153	anti 133, 129, syn 182 4				or br	red br	1	
93	2,3,4,5-Tetrachlorobenzaldehyde	106 6 5													
94	2,3-Dihydroxybenzaldehyde	108		226d			167								
95	2-Chloro-5-hydroxybenzaldehyde	110 5-1 5, ac a		236, pa yel			250 1, red, dil al		146 7, abs al						
96	1-Phenanthraldehyde	111 5						189							
98	2,4,5-Trichlorobenzaldehyde	112-3, al									Ac anh + ac a + NaOAc → 2,4,5-trichlorocinnamic acid, 200 1				
99	3-Hydroxy-2,4,6-trichlorobenzaldehyde	113-6 5, 50% ac a				272-3d, yel or		170-2, dil al							
100	2-Ethoxy-1-naphthaldehyde	115, al		214-5, yel, al			91				Azine, 184, yel, PhNO <sub>2</sub> -al Dil a → acetaldehyde, b p 20 2				
101	Metalddehyde	115, 246, (polymers)													
102	4-Hydroxybenzaldehyde	116-7, w		224, 280d	280d, purp, ac a, 260 (monohyd), red, w	266	177 8, al, 184, slow htng	72, 112 (anh)	188-90 (cor), 184	246		dk or red	ch red	5	
103	Terephthalaldehyde	116, 118	245			di 281	di 278d, 154	di 200							
104	2,4,6-Trimethoxybenzaldehyde	118						201-3, me al							

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	Semi carbazone	2,4-Dinitrophenyl hydrazone	p-Nitrophenyl hydrazone	Phenyl hydrazone	Oxime	Dimethone deriv (Dime done deriv)	Dimethone anhydride	Miscellaneous	o-Dianisidine spot test		
												Cold	Hot	Limit γ
105	1-Bromo-2-naphthaldehyde	118									Oxid → acid 186			
106	4-Chloro-3-hydroxybenzaldehyde	121		238 9, pa yel		226 7 vit red dil al		126 (anh) 106 10d (monohyd)						
107	Pyrene-3-carboxaldehyde	126												
108	1,2,3,4-Tetrahydrophenanthrene-9-carboxaldehyde	129												
109	4,6-Dichloro-3-hydroxybenzaldehyde	129 30									2 Nitro deriv 157			
110	2,4-Dihydroxybenzaldehyde (β-Resorcylaldehyde)	135-6, yel, w		260d	286d brt red AmOH		156 60d	191, w						
111	3-Chloro-4-hydroxybenzaldehyde	139 (cor)		210d, yel, v dil ac a				144 5, w						
112	2-Chloro-3-hydroxybenzaldehyde	139 9 5		236 7, pa yel		244 5 or red, al		149 dil al						
113	2,6-Dichloro-3-hydroxybenzaldehyde	140 2						174 5 dil al						
114	2,4-Dichloro-3-hydroxybenzaldehyde	141, ac a				277 8, or red		188, al						
115	d,l-Glyceraldehyde (dimer)	142, 40°, me al		160d	166 7 (cor), 50°, me al			117 8	197 (cor) 50°, al 203	172 50°, al				
116	2-Chloro-4-hydroxybenzaldehyde	147 8 w		214, yel al		284d dk red al		194 al						
117	3,4-Dihydroxybenzaldehyde (Protocatechualdehyde)	153 4, w		230d	275d, dk red, me al		175 6d, w 121 8	157, xyl al	145d, al		Dibenzoate 96 7, al			
118	3,5-Dihydroxybenzaldehyde (α-Resorcyclic aldehyde)	156 7		223 4										
119	3,5-Dichloro-4-hydroxybenzaldehyde	158 9 (cor), 156, dil al		236 7d (cor), grn-yel, ac a				185, dil al						
120	Hydroxypyruvic aldehyde	160						135						
121	Diphenylglycolaldehyde	163		242				124						
122	Benzaldehyde-3-carboxylic acid (3-Formylbenzoic acid)	175, w		265			164	188d						

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
**b) Solids ( Listed in order of increasing m.p.)\* ( Continued)**

No	Name	Melting point, °C	Boiling point, °C	Semi carba zone	2,4-Di nitro-phenyl-hydrazone	p Nitro phenyl-hydrazone	Phenyl-hydrazone	Oxime	Dimeth one deriv (Dime-done deriv)	Di-meth one anhy dride	Miscellaneous	o-Dianisidine spot test		
												Cold	Hot	Limit 7
123	2-Hydroxybenzaldehyde-3-carboxylic acid (3-Formyl-salicylic acid)	179					188, al	193, yel, w						
124	4-Hydroxy-1-naphthaldehyde	181, yel, w		224							Hydrazone, 220-36, dk red Azine, 236, yel, PhNO <sub>2</sub>			
125	Indole-3-carboxaldehyde	195, 198					198							
126	Pentachlorobenzaldehyde	202.5					152.5 (cor), yel, al	201 (cor), bz						
127	3,4-Benzopyrene-5-carboxaldehyde	203												
128	3,4,5-Trihydroxybenzaldehyde (Gallaldehyde)	212d, (mono-hyd)				226, 234-6d		195-200d						
129	4-Hydroxybenzaldehyde-3-carboxylic acid (5-Formyl-salicylic acid)	248-9					219, al	179						
130	Benzaldehyde-4-carboxylic acid (4-Formylbenzoic acid)	256, w, subl					226	208-10						

\*Derivative data given in order m p, crystal color, solvent from which crystallized



## EXPLANATIONS AND REFERENCES TO TABLES IX AND X (Continued)

From the carbonyl compound in ethanol with 2,4-dinitrophenylhydrazine in 85% phosphoric acid

See Vogel, p 344, G D Johnson, *J Amer Chem Soc*, **73**, 5888 (1951), **75**, 2720 (1953)

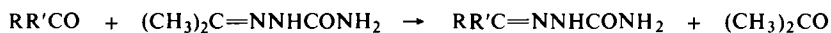
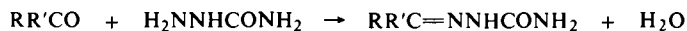
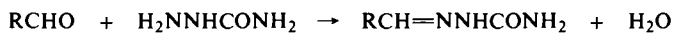
From the carbonyl compound with 2,4-dinitrophenylhydrazine and sulfuric acid in isopropyl alcohol

See N R Campbell, *Analyst*, **61**, 391 (1936)

From the carbonyl compound with 2,4-dinitrophenylhydrazine in pyridine

See E A Braude and C J Timmons, *J Chem Soc*, 3131 (1953)

### Semicarbazone \*



Semicarbazone

From the carbonyl compound with aqueous semicarbazide hydrochloride and sodium acetate

For directions and examples see Cheronis, pp 503-504, 512, Shriner, p 218, Vogel, p 344, Wild, p 121, A Michael, *J Amer Chem Soc*, **41**, 417 (1919)

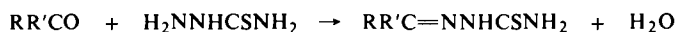
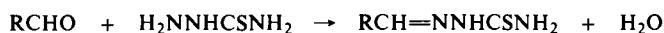
From the carbonyl compound in ethanol with aqueous semicarbazide hydrochloride and sodium acetate

See Linstead, p 27, Shriner, p 218, Wild, p 122, R L Shriner and T A Turner, *J Amer Chem Soc*, **52**, 1267 (1930)

From the carbonyl compound and acetone semicarbazone in acetic acid

See B Angla, *Ann Chim Anal Chim Appl*, **22**, 10 (1940)

### Thiosemicarbazone \*

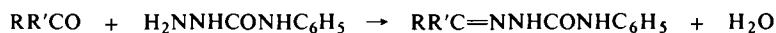
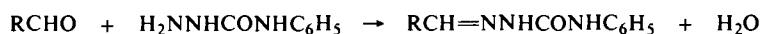


Thiosemicarbazone

From the carbonyl compound with thiosemicarbazide and sodium acetate in water, alcohol or acetic acid

For directions and examples see Cheronis, pp 503, 512, Wild, p 128, F J Wilson and R Burns, *J Chem Soc*, **121**, 873 (1922), W Baird, R Burns and F J Wilson, *J Chem Soc*, 2527 (1927), M Busch, *J prakt Chem*, **124**, 301 (1930), P P T Sah and T C Daniels, *Rec Trav Chim*, **69**, 1545 (1950)

### Phenylsemicarbazone \*

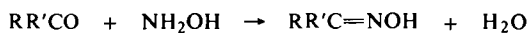
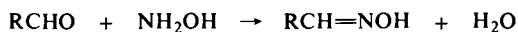


Phenylsemicarbazone

From the carbonyl compound with phenylsemicarbazide in alcohol or acetic acid

For directions and examples see P P T Sah and T-S Ma, *J Chinese Chem Soc*, **2**, 32 (1934), C A, **28**, 3713 (1934)

### Oxime \*



Oxime

From the carbonyl compound with hydroxylamine hydrochloride and pyridine in ethanol or without solvent

For directions and examples see Cheronis, p 513, Shriner, p 254, Vogel, p 345, J B Buck and W S Ide, *J Amer Chem Soc*, **53**, 1536 (1931), W E Bachmann and C H Boatner, *J Amer Chem Soc*, **58**, 2097 (1936), W E Bachmann and M X Barton, *J Org Chem*, **3**, 300 (1938)

For a modification of the above method in aqueous alcohol

See W M D Bryant and D M Smith, *J Amer Chem Soc*, **57**, 57 (1935)

From the carbonyl compound with hydroxylamine hydrochloride and sodium hydroxide in methanol or aqueous ethanol

### \*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLES IX AND X (Continued)

See: Cheronis, p. 513; Shriner, p. 255; Vogel, p. 721; Wild, p. 121.

From the carbonyl compound with hydroxylamine hydrochloride and potassium hydroxide in 95% ethanol.

See: Shriner, p. 255.

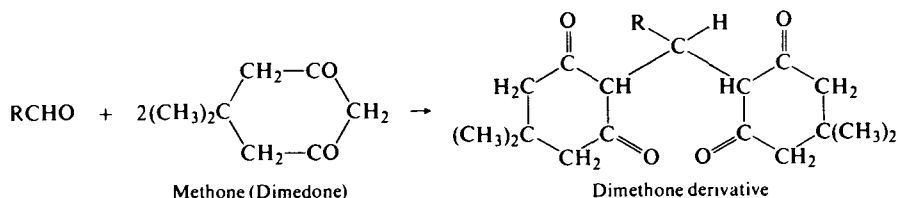
From the carbonyl compound with hydroxylamine hydrochloride and sodium or potassium acetate in water or aqueous ethanol.

See: Linstead, p. 27; Vogel, pp. 343, 345; J. S. Buck and W. S. Ide, *J. Amer. Chem. Soc.*, **53**, 1536 (1931).

From the carbonyl compound with hydroxylamine hydrochloride and sodium carbonate or bicarbonate in water or aqueous ethanol.

See: Wild, p. 120.

*Dimethone derivative (Methone derivative).\**



*This derivative is specific for aldehydes only.*

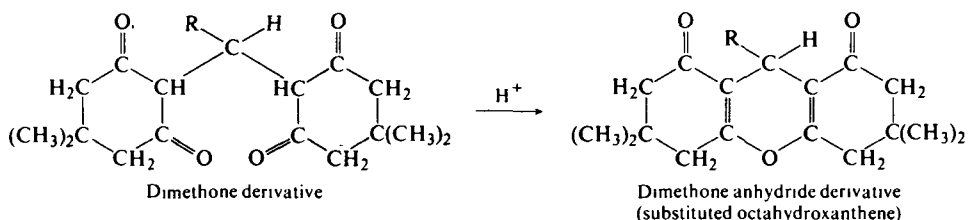
From the aldehyde and methone (dimedone; 5,5-dimethyl-1,3-cyclohexanedione; dimethyl dihydroresorcinol) in aqueous ethanol or methanol.

For directions and examples see: Cheronis, p. 505; Linstead, p. 27; Shriner, p. 220; Vogel, p. 333; Wild, pp. 136-7; D. Vorlander, *Z. Anal. Chem.*, **77**, 241 (1929); *Z. Angew. Chem.*, **42**, 46 (1929); W. Weinberger, *Ind. Eng. Chem., Anal. Ed.*, **3**, 365 (1931).

From the aldehyde with methone and a catalytic amount of piperidine in aqueous ethanol.

See: E. C. Horning and M. G. Horning, *J. Org. Chem.*, **11**, 95 (1946).

*Anhydride of dimethone derivative (substituted octahydroxanthene).\**



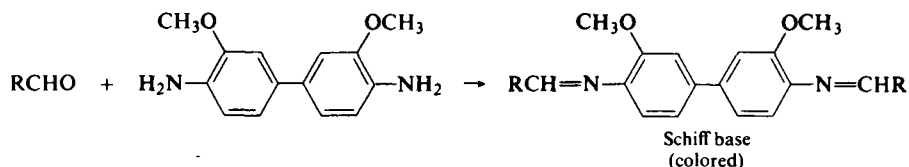
From the dimethone derivative with acetic anhydride.

For directions and examples see: Cheronis, p. 505; Vogel, p. 333.

From the dimethone derivative and a catalytic amount of hydrochloric acid in water or in ethanol.

See: Cheronis, p. 505; Linstead, p. 27; Shriner, p. 220; Vogel, p. 333; Wild, p. 137; E. C. Horning and M. G. Horning, *J. Org. Chem.*, **11**, 95 (1946).

*o-Dianisidine spot test.*



*This test is usually applicable to aldehydes only.*

From the aldehyde and a saturated solution of *o*-dianisidine (4,4'-diamino-3,3'-dimethoxybiphenyl) in glacial acetic acid.

For directions and examples see: F. Feigl, *Spot Tests in Organic Analysis*, 6th Ed., Elsevier Publishing Co., New York, 1960, p. 225; R. Wasicky and O. Frehden, *Mikrochim. Acta*, **1**, 55 (1927).

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	Semi carbazone	2,4-Di-nitrophenyl hydrazone	<i>p</i> -Nitrophenyl hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
1	Acetone (2-Propanone)	56	-95	1.3592		190 w	126 128 vcl al	148 9 yel al	42	59	Thiosemicarbazone 179
2	3-Buten-2-one (Methyl vinyl ketone)	81		1.4095 <sup>2</sup>		141 140					
3	2-Butanone (Ethyl methyl ketone)	80-82	86.4	1.3791	0.804	146	116 7 115 ycl al	128 9 vcl w al	oil	b p 152	Phenylsemicarbazone 168
4	3-Butyn-2-one (Ethynyl methyl ketone)	86					181	143			
5	2,3-Butanedione (Biacetyl)	88 gr vcl	f p 2.4	1.3927		mono 235 (cor) w di 278 9 c a	di 314 s (cor) red or PhNO	mono 230 or yel	mono 134 yel dil al di 243d yel bz	mono 76 di 245 6 (cor) 234 5 subl dil al oil	
6	2-Methyl-3-butanone (Isopropyl methyl ketone)	94 3		1.3879	0.8046	113 4 112 3 dl	120 117 or vcl al chl	108 9 or yel al	oil		
7	2-Methyl-1-buten-3-one (Isopropenyl methyl ketone)	97 <sup>1</sup>		1.4232 1.4235		173	181				
8	Cyclobutanone	100		1.4189			146				
9	3-Pentanone (Diethyl ketone)	102	39.8	1.3922		138 9	156 p or al	144 or yel 50 il	oil	b p 165	
10	2-Pentanone (Methyl <i>n</i> -propyl ketone)	103 3		1.3902 1.39012	0.80639	112 106	143 4 vcl or al	117	oil	b p 167	
11	1-Penten-3-one (Ethyl vinyl ketone)	107 <sup>1</sup>		1.4192			129				
12	3,3-Dimethyl-2-butanone ( <i>tert</i> -Butyl methyl ketone. Pinacolone)	106	49.8	1.3960 1.3956	0.8114	157 8	125 or vcl al fusion 131		oil	75 79	
13	1-Methoxy-2-propanone (Methoxymethyl methyl ketone)	115		1.3981			163 159	111 109			
14	1-Methoxy-3-butanone (1-Methoxyethyl methyl ketone)	116		1.3936		141					
15	4-Methyl-2-pentanone (Isobutyl methyl ketone)	116 8		1.3956	0.8008	132 135	95 or red al			b p 176	
16	3-Methyl-2-pentanone ( <i>sec</i> -Butyl methyl ketone)	118		1.3990		94 5 pet c th	71 2			oil b p 89 <sup>21</sup>	
17	1-Chloro-2-propanone (Chloroacetone)	119				150 164d	125			b p 171 <sup>21</sup>	
18	2-Methyl-1-penten-3-one (Ethyl isopropenyl ketone)	119		1.4270 <sup>1</sup>		161					
19	1,1-Dichloro-2-propanone (1,1-Dichloroacetone)	120			1.305 <sup>2</sup>	163					
20	2,4-Dimethyl-3-pentanone (Diisopropyl ketone)	124		1.4001	0.8108	160 (cor) 149	88 85 6 or 94 8				
21	Methyl neopentyl ketone	125 122		1.4018 <sup>25</sup>			100				
22	3-Hexanone (Ethyl <i>n</i> -propyl ketone)	125		1.4007	0.81491 <sup>2</sup>	113	130			b p 86 <sup>17</sup>	
23	2,2-Dimethyl-3-pentanone ( <i>tert</i> -Butyl ethyl ketone)	125 <sup>23</sup>		1.4052			144				
24	2-Hexanone ( <i>n</i> -Butyl methyl ketone)	128		1.40069	0.81127	125 (cor) 121 rapid htng	106 red or al 110	88	oil	49	Thiosemicarbazone 110

\*Derivative data given in order: m p, crystal color, solvent from which crystallized.

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	Semi carbazone	2,4-Di-nitrophenyl hydrazone	<i>p</i> -Nitrophenyl hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
25	<b>4-Methyl-3-penten-2-one</b> (Isopropylideneacetone Mesityl oxide)	130		1 44397	0 86532	$\alpha$ 164 $\beta$ 133 4, bz	200, red, al, 203, red, ac a 112	132 4, or -yel, al	142	$\beta$ 48-9, me al	
26	<b>3,3-Dimethyl-2-pentanone</b> ( <i>tert</i> -Amyl methyl ketone)	130 <sup>733</sup>		1 4100							
27	<b>Cyclopentanone</b>	130 7	-51 3	1 4366 1 4370	0 94869	210 203, 216-7, rapid htng	146, or ac a, 142, or -yel, al	154	55, lt pet	56 5, pet eth	
28	<b>5-Hexen-2-one</b> (Allylacetone)	132		1 4174 <sup>25</sup>		102	108				
29	<b>1-Methoxy-2-butanone</b> (Ethyl methoxymethyl ketone)	133 <sup>757</sup>		1 4063			198				
30	<b>2,2,4-Trimethyl-3-pentanone</b> ( <i>tert</i> -Butyl isopropyl ketone)	135		1 4065		132				144	
31	<b>5-Methyl-3-hexanone</b> (Ethyl isobutyl ketone)	135 <sup>735</sup>		1 407		152					
32	<b>2-Methyl-1-penten-4-one</b>	135 45d				192					
33	<b>1-Bromo-2-propanone</b> (Bromoacetone)	136				135d				36	
34	<b>2-Methyl-3-hexanone</b> (Isopropyl <i>n</i> -propyl ketone)	136		1 4075		119					
35	<b>4-Methyl-3-hexanone</b> ( <i>sec</i> -Butyl ethyl ketone)	136		1 402		137	78				
36	<b>2-Methoxy-3-pentanone</b> (Ethyl 1-methoxyethyl ketone)	136 <sup>750</sup>		1 4019		120					
37	<b>Cyclobutyl methyl ketone</b>	136		1 4283 <sup>28</sup>		149					
38	<b>3-Methyl-2-hexanone</b>	137				70					
39	<b>3-Methyl-1-hexen-5-one</b>	138		1 4197 <sup>25</sup>		112					
40	<b>1-Chloro-2-butanone</b> (Chloromethyl ethyl ketone)	138		1 4372							
41	<b>3-Methyl-1-penten-4-one</b>	138				201				75 6	
42	<b>3,4-Dimethyl-2-pentanone</b>	138		1 4094		113					
43	<b>4-Hexen-3-one</b>	139		1 4388		157					
44	<b>2,4-Pentanedione</b> (Acetylacetone)	139	-30	1 4465 <sup>25 6</sup>	0 976	<i>mono</i> 122, <i>di</i> 209	209, yel, al			<i>di</i> 149, al <i>b p</i> 103 <sup>22</sup>	
45	<b>2-Methylcyclopentanone</b>	139		1 4364		184, 182					
46	<b>3-Ethyl-2-pentanone</b>	139 <sup>746</sup>		1 4073		99					
47	<b>3-Hydroxy-3-methyl-2-butanone</b> (Acetyl diethyl carbinol)	140				165				87	
48	<b>4-Methyl-2-hexanone</b>	142, 139		1 4057 <sup>25</sup>		120, 128					
49	<b>1-Propoxy-2-propanone</b> (Isopropoxymethyl methyl ketone)	142		1 4004			142 144				
50	<b><i>d</i>-3-Methylcyclopentanone</b>	143		1 4340 <sup>19</sup>		184 5				$\alpha$ 91-2, $\beta$ 67-9	$[\alpha]_D^{25} + 132 9$
51	<b>3,4-Dimethyl-4-penten-2-one</b>	144				114					
52	<b>4-Heptanone</b> (Di- <i>n</i> -propyl ketone)	144	-34 0	1 4069	0 8175	132, pet eth	75, yel - or, al 71			<i>b p</i> 193	
53	<b>2,4-Dimethyl-3-hexanone</b> ( <i>sec</i> -Butyl isopropyl ketone)	145		1 4059, 1 4080							
54	<b>3-Hydroxy-2-butanone</b> ( <i>d l</i> -Acetoin)	145, 148	-72, 15	1 4178	0 9861 <sup>30</sup>	185, al, 202	<i>di</i> 318, or, PhNO <sub>2</sub> tol				Phenylosazone, 243d, yel, bz
55	<b><i>d l</i>-3-Methylcyclopentanone</b>	145 <sup>755</sup>		1 4329		185					
56	<b>1-Methoxy-3-methyl-2-butanone</b> (Isopropyl methoxymethyl ketone)	145 <sup>748</sup>		1 4078			163				

\*Derivative data given in order m p, crystal color, solvent from which crystallized



**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Semi-carbazone	2,4-Di-nitrophenyl hydrazone	<i>p</i> -Nitrophenyl hydrazone	Phenylhydrazone	Oxime	Miscellaneous
57	2,2-Dimethyl-3-hexanone ( <i>tert</i> -Butyl <i>n</i> -propyl ketone)	145 <sup>738</sup>		1.4107			124, 116				
58	1-Hydroxy-2-propanone (Acetol)	146	-17	1.4295		196, al	128.5 (cor), or, al 116	173			
59	4-Chloro-3-methyl-2-butanone ( $\alpha$ -Chloroisopropyl methyl ketone)	146		1.4390							
60	1-Hepten-4-one	146.7				110, w-al					b.p. 92.3 <sup>13</sup>
61	3,4-Dimethyl-3-penten-2-one	147		1.4506 <sup>14</sup>		200					
62	1-Ethoxy-2-butanone (Ethoxy-methyl ethyl ketone)	147 <sup>752</sup>		1.4068							
63	2,5-Dimethyl-3,4-hexanedione (Di-isobutyryl)	148		1.42057							mono 125, di 172
64	3-Heptanone ( <i>n</i> -Butyl ethyl ketone)	148		1.4092		101, 103, 152					
65	5-Methyl-4-hexen-3-one	148		1.4496 <sup>15</sup>		163					
66	5-Methyl-5-hexen-2-one (Methylallylacetone)	149		1.4285 <sup>25</sup>		137					
67	2-Methyl-4-heptanone (Isobutyl <i>n</i> -propyl ketone)	150 <sup>750</sup>				124					
68	4,4-Dimethyl-3-hexanone ( <i>tert</i> -Amyl ethyl ketone)	150.2				98					
69	2-Heptanone ( <i>n</i> -Amyl methyl ketone)	151.2	-35.5	1.40069		123, al, 127	89, yel or, al 74		207		
70	3-Ethyl-5-hexen-2-one	152		1.4260 <sup>26</sup>							
71	5-Hepten-2-one (Crotylacetone)	153		1.4280 <sup>25</sup>	0.8446	105, 97					
72	1-Methoxy-2-pentanone (Methoxymethyl <i>n</i> -propyl ketone)	153 <sup>745</sup>		1.4119							
73	3,3-Dimethylcyclopentanone	153 <sup>748</sup>				178					
74	2,2,4,4-Tetramethyl-3-pentanone (Di- <i>tert</i> -butyl ketone)	154		1.4392, 1.4194							
75	1-Bromo-2-butanone (Bromo-methyl ethyl ketone)	155, 50 <sup>12</sup>		1.4670							
76	Cyclopentyl methyl ketone	155				143					
77	2,2,5,5-Tetramethylcyclopentanone	155		1.4280							
78	1-Methoxy-3-hexanone (1-Methoxyethyl <i>n</i> -propyl ketone)	155 <sup>746</sup>		1.4091		169, 170					
79	Cyclohexanone	156	-16.4	1.4507		166-7	160, 162, yel al 80	146.7, 90% al	81.2, 50% al	91, lgr	
80	4-Methyl-6-hepten-3-one	156									
81	2-Hepten-4-one	156.7				147, w-me al					
82	2,3-Hexanedione	158									di 175
83	3,4-Dimethyl-2-hexanone	158, 155				120, 118, 126					
84	3,4-Dimethyl-3-hexen-2-one	158		1.4476 <sup>15</sup>		142					
85	2,2,4-Trimethyl-3-hexanone ( <i>tert</i> -Butyl isobutyl ketone)	158				145					
86	2-Ethyl-1-hexen-3-one	158 <sup>742</sup>		1.4408 <sup>18</sup>		119					
87	3,3-Dimethyl-1-methoxy-2-butanone ( <i>tert</i> -Butyl methoxymethyl ketone)	159 <sup>744</sup>		1.4193							
88	1-Isopropoxy-3-methyl-2-butanone	160					88				
89	2-Methyl-3-cyclopentanone	161		1.4771		220				127	

\*Derivative data given in order: m.p., crystal color, solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Semi carbazone	2,4-Di-nitrophenyl-hydrazone	<i>p</i> -Nitro-phenyl-hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
90	1-Ethylcyclopentanone	161 <sup>755</sup>				189					
91	3-Methyl-2-heptanone	162		1.415		82					
92	4,5-Dimethyl-5-hexen-3-one	162 <sup>750</sup>				110					
93	3,5-Dimethyl-4-heptanone (Di-sec-butyl ketone)	162, 170-3				83-4					
94	6-Methyl-3-heptanone (Ethyl isoamyl ketone)	163, 160				132					
95	2-Methoxy-3-methyl-2-pentanone (sec-Butyl methoxymethyl ketone)	164 <sup>757</sup>		1.4162							
96	1-Methoxy-4-methyl-2-pentanone (Isobutyl methoxymethyl ketone)	164 <sup>751</sup>		1.4140							
97	2-Methylcyclohexanone	165.1, 166	-14.0	1.4885	0.92500	191, 197d, al, rapid htng	135.5, 70, al, 137 (cor), 202.3	132	b.p. 220 <sup>15-11</sup>	43, eth	
98	4-Hydroxy-4-methyl-2-pentanone (Diacetone alcohol)	166, 164								58	3,5-Dinitrobenzoate, 55
99	4,5-Dimethyl-4-hexen-3-one	166 <sup>750</sup>				209					
100	2,2-Dimethyl-3-heptanone ( <i>n</i> -Butyl <i>tert</i> -butyl ketone)	166 <sup>745</sup>		1.4167		145					
101	2,6-Dimethyl-4-heptanone (Di-isobutyl ketone, Isovalerone)	168.0		1.4173 <sup>25</sup>		122, 126	66, or -red 92				
102	2-Methyl-4-octanone ( <i>n</i> -Butyl isobutyl ketone)	168				132					
103	2,5-Dimethyl-4-heptanone (sec-Butyl isobutyl ketone)	169, 167				133					
104	<i>d</i> -3-Methylcyclohexanone	169		1.4456 <sup>21</sup>		180, me al				43	$[\alpha]_D^{20} +13.38$
105	<i>d</i> -1-3-Methylcyclohexanone	168, 169.6	-73.5	1.4430, 1.4463	0.91535	179, me al, 191.4d, rapid htng	155, yel	119	94, w-al		
106	1-Methoxy-2-hexanone ( <i>n</i> -Butyl methoxymethyl ketone)	169 <sup>744</sup>		1.4173							
107	4-Octanone ( <i>n</i> -Butyl <i>n</i> -propyl ketone)	170				96					
108	Methyl acetoacetate	170	-40.6	1.41964	1.0765	152					
109	2,2-Dimethylcyclohexanone	170, 171		1.4482		201, 193	140-2				
110	6-Methyl-2-heptanone (Isohexyl methyl ketone)	171		1.4146		154	77				
111	<i>trans</i> -2,4-Dimethylcyclohexanone	171		1.4429 <sup>16</sup>		136					
112	4-Methylcyclohexanone	171.25	-40.6	1.4445	0.91562	199, me al, 203.5d, rapid htng		128.5, yel, al	109.10, al	37.9	
113	<i>d,l</i> -2,5-Dimethylcyclohexanone	171-3		1.4446		$\alpha$ 122, $\beta$ 173				111, al	
114	2-Octanone (Hexyl methyl ketone)	173	-21.5	1.41518, 1.4154	0.81853	122.3 (cor), pet eth-al	58, or, al	92.3, yel, al			
115	5-Ethyl-3-heptanone	173				134					
116	<i>d</i> -2,5-Dimethylcyclohexanone	173-4				176.7				97.8	$[\alpha]_D^{20} +11.6$
117	3-Ethyl-2-methylcyclopentanone	174				170, al					

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Semi-carbazone	2,4-Di-nitrophenyl-hydrazone	<i>p</i> -Nitro-phenyl-hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
118	2,6-Dimethylcyclohexanone	174		1 4500, 1 4470							
119	2-Isopropylcyclopentanone	174		1 4395 <sup>29</sup>		202					
120	Acetoxyacetone	174-5, 74 <sup>18</sup>		1 4150	1 0749	145 me al		144, yel, bz	60d, eth	b p 144 <sup>20</sup>	
121	2,4-Heptanedione ( <i>n</i> -Butyryl-acetone)	174 5									Cu salt, 165 161, pa bl
122	3-Methyl-3-hepten-2-one	175				164					
123	<i>cis</i> -2,4-Dimethylcyclohexanone	176		1 4430 <sup>25</sup>		200, 190				98 9	
124	4-Ethyl-4-hydroxy-3-hexanone	178 <sup>742</sup>				177					
125	2,3-Dimethylcyclohexanone	178-9		1 4505		203-4					
126	2,2,6-Trimethylcyclohexanone	179 <sup>767</sup>		1 4480		209	141				
127	3,3-Dimethylcyclohexanone	179 <sup>748</sup>		1 4482 <sup>17</sup>		219					
128	5-Ethyl-4-hepten-3-one	179 <sup>740</sup>				105					
129	3-Ethyl-4-methylcyclopentanone	180				208-9 w-al				oil, b p 117 <sup>11</sup>	
130	Cyclohexyl methyl ketone	180		1 4514		177		154		60	
131	<i>trans</i> -3,5-Dimethylcyclohexanone	<i>d l</i> 180 1		1 4475 <sup>21</sup>	<i>d l</i> 0 897 <i>d</i> 0 9083 <i>l</i> 0 9074	<i>d l</i> 193-4, <i>d</i> 193-4, <i>l</i> 189				<i>d l</i> oil, b p 116-8 <sup>14</sup>	<i>d</i> [ $\alpha$ ] <sub>D</sub> <sup>20</sup> +4 65 <i>l</i> [ $\alpha$ ] <sub>D</sub> <sup>20</sup> -7 91
132	5-Hydroxy-4-octanone (Butyrolin)	180-90					99				
133	Ethyl acetoacetate	181				133, 129d	93				
134	Cycloheptanone	181, 182				163	148	137		23	
136	<i>cis</i> -3,5-Dimethylcyclohexanone	182-3		1 4407	0 890	202 3				74	
137	2-Propylcyclopentanone	183		1 4429		214d, al				oil, b p 109-11 <sup>9</sup>	
138	2,2,6,6-Tetramethylcyclohexanone	184 <sup>722</sup>	15	1 4473							
139	3-Methyl-2,4-hexanedione	184 183									Cu salt, 177
140	5-Nonanone (Di- <i>n</i> -butyl ketone)	186-7	f p -5 9	1 421 <sup>15</sup>	0 8222	90, al					
141	3,4-Dimethylcyclohexanone	187		1 4520 1 4507	0 906	189					
142	3-Nonanone (Ethyl <i>n</i> -hexyl ketone)	187 <sup>751</sup>				112					
143	2,5-Dimethylcyclohexen-3-one	189 90		1 4753 <sup>22</sup>		165, me al				92 3, me al 169, al 121	
144	Methyl 2-pyridyl ketone (2-Acetyl-pyridine)	190									
145	3-Propylcyclopentanone	190-1		1 4456 <sup>12</sup>		178 9, me al				oil, b p 121 2 <sup>12</sup>	
146	3-Ethylcyclohexanone	192		1 4537, 1 4511		182, 175					
147	1,5-Dimethylcyclohexen-4-one	192-3, 194								102	
148	2,5-Hexanedione (Acetonyl-acetone)	194	-9	1 428, 1 449	0 97370	<i>mono</i> 185d, <i>di</i> 224	<i>di</i> 257 pyr	<i>di</i> 210 2 red al	<i>di</i> 120, <i>dil</i> al	<i>mono</i> b p 130 <sup>11</sup> , <i>di</i> 137	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Semi-carbazone	2,4-Dinitrophenylhydrazone	p-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Miscellaneous
149	<i>d</i> -Fenchone	195-6		1.46355 <sup>18</sup>	0.947 <sup>19</sup>	184, 172	140		b p 202-3 <sup>18</sup>	<i>d</i> or <i>l</i> α+ 165 β+ 123, <i>d l</i> α+ 159 β+ 129	Hydrazone 56 7
150	2-Nonanone ( <i>n</i> -Heptyl methyl ketone)	195.3	-8	1.42072	0.82133 0.82217	118.9 al					
151	1-Acetyl-4-methylcyclohexanone	195-7		1.4509 <sup>18</sup>		α 159, me al β 175				57.9	
152	Methyl levulinate	196.0		1.42333	1.04945	143	142, al		96 105, al		
153	4-Fluoroacetophenone	196		1.5081 <sup>25</sup>		219					
154	<i>d l</i> -2-Ethyl-5-methylcyclohexanone	197		1.4485		178-81				80, w-al	
155	1-Acetyl-2-methylcyclohexanone	197 200				172.3					
156	2- <i>n</i> -Propylcyclohexanone	198-9 <sup>74h</sup>		1.4558 <sup>13</sup>		133d, w-al				67.8	
157	1-Acetylcyclohexene	200		1.4892		220				59	
158	3-(Trifluoromethyl)acetophenone	202									
159	β-Thujone	202, 76 <sup>10</sup>				174	114				
160	Acetophenone (Methyl phenyl ketone)	205, 202	20	1.541 1.5339	1.02810	198-9 (cor), 50% al, 203	238-40, al, 249-50, or-red, ac a	184-5, or-red	105, wh, al, → dk	60	
161	2-Ethyl-4-methylcyclohexanone	205 <sup>747</sup>		1.4452							
162	Ethyl levulinate	206		1.42288	1.01114	148	102		104		
163	4-Decanone	206.7				51.2					
164	1,5-Dimethylcyclohexen-3-one	208-9		1.4819 <sup>22</sup>		179-80, yel, al, 168.71			76.8		Thiosemicarbazone, 195d
165	<i>l</i> -Menthone	209, 207	-6.6	1.4505		189, 187, 184	146, or, al		53	59, eth	
166	2-Decanone (Methyl <i>n</i> -octyl ketone)	211, 215.5	14, f p 3.1	1.42523	0.82370	124, 126, pet eth					
167	Methyl 4-pyridyl ketone	212								142	
168	4- <i>n</i> -Propylcyclohexanone	212 <sup>740</sup>		1.4514 <sup>25</sup>		180					
169	2-Acetylthiophene (Methyl 2-thienyl ketone)	213	10.5	1.5666		190, bz		181	96	81	
170	2-Methylacetophenone (Methyl 2-tolyl ketone)	214, 216		1.5320		205, al, 210	159, yel, al 161			61	
171	6-Bromo-2-hexanone	214 <sup>720</sup>		1.4713			81				
172	1,5,5-Trimethylcyclohexen-3-one (Isophorone)	215		1.4789 <sup>21.5</sup>	0.9255 <sup>20.5</sup>	199.5d, al, 191			68, dil al	79.5, pet eth, 76	Picrate, 75
173	<i>n</i> -Propyl 2-pyridyl ketone	217-8							82		
174	Propiophenone (Ethyl phenyl ketone)	218, 220	20, 18.6	1.5270	1.0105	173.4 (cor), al, 182, rapid htng	190.1, red, bz, 189			54, 53, pet eth	
175	Methyl 3-pyridyl ketone	220, 218							137	113	
176	3-Methylacetophenone (Methyl 3-tolyl ketone)	220		1.5306	1.007	198, 203	207			55, 57, al	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Semi-carbazone	2,4-Di-nitrophenyl-hydrazone	<i>p</i> -Nitro-phenyl-hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
177	<b>Isobutyrophenone</b> (Isopropyl phenyl ketone)	222 217		1.5190	0.9863 <sup>14</sup>	181, al	163, or -red, dil ac a		73	94, lt pet	
178	<b>Acetyl benzoyl ketone</b>	222, yel		1.537 <sup>10</sup>		<i>dt</i> 229 32		<i>dt</i> 256	$\alpha$ 143	$\alpha$ , <i>mono</i> 166, $\beta$ , <i>mono</i> 114 <i>dt</i> 240	
179	<b>5-Ethyl-1-methylcyclohexene-3-one</b>	223.7				162.8d, al					Thiosemicarbazone, 150.1
180	<b>4[8]-<i>p</i>-Menthen-3-one</b> (Pulegone)	224, 221.2		1.48705 <sup>18</sup>		174.175.6	142			119	
181	<b>Pivalophenone</b> ( <i>tert</i> Butyl phenyl ketone)	224.7 <sup>11</sup>		1.5082 1.5102		150	194.5			167	
182	<b>1-Phenyl-2-butanone</b> (Benzyl ethyl ketone)	226				135.146					
183	<b>6-Undecanone</b> (6-Hendecanone Di- <i>n</i> -amyl ketone)	228 (cor)	15	1.42875	0.82471	oil				oil	
184	<b>3-Chloroacetophenone</b>	228				232		176		88	
185	<b>Ethyl 1-thienyl ketone</b>	228				167				55-6	
186	<b>2-Undecanone</b> (2-Hendecanone Methyl <i>n</i> -nonyl ketone)	228	12.1 12.7	1.42899	0.82564	122.0.5	63, al	90.1, yel, al		44.5	
187	<b>2,4-Dimethylacetophenone</b>	228 234.5		1.5381 1.5340		185.7				63.4, eth	
188	<b>2-Chloroacetophenone</b>	229		1.685 <sup>25</sup>		160				113	
189	<b>1-Phenoxy-2-propanone</b> (Phenoxyacetone)	229 30 120 <sup>11</sup>		1.5228	1.0903	173, 176 (cor), 50% al					
190	<b><i>n</i>-Propyl 4-pyridyl ketone</b>	229.31									Picrate, 96
191	<b><i>n</i>-Butyrophenone</b> (Phenyl <i>n</i> -propyl ketone)	230, 218 21	11.5 13.0	1.5196 1.5203		187.8, al, 191	190, or -red, dil ac a			50, abs eth	
192	<b><i>d</i>-Carvone</b>	230		1.49952	0.9608	162-3, 142.3, <i>d</i> / 154.6	191, red, ac a	174.5, red-br		<i>d</i> $\alpha$ 72-3, al <i>d</i> , $\beta$ 56-7, 1, $\alpha$ , (-) 72, 1, $\beta$ , (+) 57-8, <i>d</i> , 1 93-4	$[\alpha]_D^{20} +62.9$
193	<b>2,5-Dimethylacetophenone</b>	230		1.5291 1.5306		168.9					
194	<b>4-Chloroacetophenone</b>	232 236	12			204 160, 146	231	239	114	95	
196	<b>4-Phenyl-2-butanone</b> (Methyl- $\beta$ -phenylethyl ketone)	235				142				87	
197	<b>Isovalerophenone</b> (Isobutyl phenyl ketone)	236				210				76, 64.5	
198	<b>3,5-Dimethylacetophenone</b>	236.7		1.5276 <sup>25</sup>				179.80, yel, ac a		114, me al	
199	<b>2-Methoxyacetophenone</b> (2-Acetylanisole)	239, 245		1.5395	1.089	183			114, al	83, 96.0 5, pet	
200	<b>3-Methoxyacetophenone</b> (3-Acetylanisole)	240, 252		1.5583 <sup>15</sup> , 4	1.0993 <sup>15</sup> , 4	196					
201	<b>5-Phenyl-3-pentanone</b>	244		1.5125		80					
202	<b>5-Isopropyl-2-methylacetophenone</b> (2-Acetyl- <i>p</i> -cymene)	245		1.51849	0.9654 <sup>20</sup>	147	140.2, clearing at 160			91-2.5	

\* Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	Semi carbazone	2,4-Di nitrophenyl-hydrazone	<i>p</i> -Nitro phenyl hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
203	$\alpha$ -Bromopropiophenone	245.50		1.5686 <sup>25</sup>							
204	3,4-Dimethylacetophenone	246.7, 251		1.5400		233.4				85	
205	2,4,5-Trimethylacetophenone	246.7				204				85.6	
206	<i>n</i> -Propyl 3-pyridyl ketone	246.52		1.5128		169.70			182		Picrate, 104
207	<i>n</i> -Valerophenone ( <i>n</i> -Butyl phenyl ketone)	248.5, 242		1.5150	0.988 <sub>20</sub> <sup>20</sup>	160, w-al	166, brt red, ac a	161.5, 2.5, or-red, al	162	52.0-5, pet eth	
208	2-Aminoacetophenone	250, 2d	20			290d, al			108, al	109, subl, w	
209	2,5-Dichloroacetophenone	251	14							130	
210	4-Isopropylacetophenone	252.4									
211	1,1,1-Tribromoacetone	255d									
212	Ethyl benzoylacetate	265				125					
213	<i>n</i> -Enanthophenone ( <i>n</i> -Hexyl phenyl ketone)	283.3	16.4	1.5076 <sub>16</sub> <sup>16</sup>	0.95155	119, dil al		127.8		55	
214	3-Phenylcyclohexanone	287.8 <sup>7,16</sup>				167, al				128.9, al	
215	1-Acetylnaphthalene (Methyl 1-naphthyl ketone)	302		1.629		288.5-9.5, 232-3			146	140, 137.5	
216	Ethyl 1-naphthyl ketone	305.7		1.6109						58	Picrate, 77-8, al, 79
217	2-Benzoylpiperidine (Phenyl 2-piperidyl ketone)	317		1.6056			199		136, yel, al	150, 165	Picrate, 130, al
218	2,4,5-Trimethylbenzophenone	328			1.0332 <sup>18</sup>						
219	2,4,4'-Trimethylbenzophenone	340									
220	$\alpha$ -Methylstyryl phenyl ketone (Dypnone)	340.5, sl d			1.108 <sub>20</sub> <sup>20</sup>	151, bz				132, al	<i>syn</i> 134, al, <i>anti</i> 78
221	1,5-Diphenyl-3-pentanone (Di-benzylacetone)	352, 348	13.4							95.6	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**a) Liquids 2) (Reduced pressure b.p. only) (Listed in order of increasing semicarbazone m.p.)\***

No	Name	Semi-carbazone	Boiling point, °C	$n_D^{20}$	$D_4^{20}$	Miscellaneous
1	1-Chloro-2-methyl-3-pentanone	70	64 <sup>9</sup>			
2	4-Methyl-2-octanone	70	94 <sup>40</sup>			
3	1-Hepten-5-one	82 3, w al	46 7 <sup>12</sup>	1 4254 <sup>18 5</sup>	0 8487 <sup>18 5</sup>	
4	3-Dodecanone	89 w -al	134 <sup>18</sup>			m p 19
5	1,3-Diethoxy-2-propanone ( <i>sym</i> -Diethoxyacetone)	91	105 <sup>35</sup>	1 4202		
6	1-Ethoxy-2-propanone (Ethoxyacetone)	96	36 <sup>28</sup>	1 4000		
7	3-Cyclopentyl-2-butanone ( $\alpha$ -Cyclopentyl- $\alpha$ -methylacetone)	98	79 <sup>17</sup>	1 4470		
8	7-Methyl-1-octen-5-one	101 2	62 3 <sup>13</sup>	1 4288 <sup>12 5</sup>		
9	Cyclohexyl methoxymethyl ketone	102	111 <sup>21</sup>	1 4552 <sup>25</sup>		
10	1-Phenoxy-2-butanone (Ethyl phenoxymethyl ketone)	102	100 <sup>5</sup>	1 5201		
11	1-Naphthoxyacetone	103	205 8 <sup>14</sup>			
12	1-Hepten-6-one	108 w - al	41 3 <sup>10</sup>	1 4350 <sup>18</sup>	0 8673 <sup>18</sup>	
13	1-Phenoxy-2-pentanone (Phenoxymethyl <i>n</i> -propyl ketone)	108	112 <sup>4</sup>	1 5148		
14	3-Octyn-2-one	109	76 <sup>15</sup>	1 4446 <sup>25</sup>		2,4-Dinitrophenylhydrazone 88
15	3-Hepten-6-one	109 10 wh	61 2 <sup>20</sup>	1 4290 <sup>21</sup>	0 8618 <sup>21</sup>	
16	3-Methyl-4-phenyl-2-butanone	112 114	130 <sup>17</sup>	1 5090 <sup>19</sup>		
17	3-Methyl-3-hepten-5-one	114	82 6 <sup>42</sup>	1 4488 <sup>25</sup>		
18	1-Chloro-2-ethyl-3-hexanone	115	92 <sup>12</sup>			
19	1,3-Dimethoxy-2-propanone ( <i>sym</i> -Dimethoxyacetone)	120	78 <sup>18</sup>	1 4174		
21	<i>trans</i> -3-Hepten-2-one	125 128	60 <sup>16</sup>	1 4421 1 4430	0 8445	
22	5-Hydroxy-5-methyl-3-heptanone	125	86 <sup>14</sup>	1 4386 <sup>14</sup>		
23	$\alpha$ -Ethoxyacetophenone	128	122 <sup>15</sup>	1 5250		
24	3-Propylpropiofenone (Ethyl 3-propylphenyl ketone)	128	145 <sup>20</sup>			
25	$\alpha$ -Methoxyacetophenone	129	126 <sup>19</sup>			
26	1-Phenyl-4-hexen-1-one	130	97 <sup>1</sup>	1 5270 <sup>25</sup>		
27	5-Phenyl-2-pentanone	130	122 <sup>6</sup>			
28	2-Methyl-3-octen-6-one	131 2	73 7 <sup>11</sup>	1 44533		
29	1-Phenyl-1-hexen-5-one	132 et ac	153 5 <sup>10</sup>	1 5458 <sup>25</sup>		
30	3-Phenyl-1-hexen-5-one	132	153 5 <sup>10</sup>	1 5193 <sup>25</sup>		2,4-Dinitrophenylhydrazone, 103
31	4-Phenyl-2-pentanone	137	115 <sup>13</sup>	1 5124		
32	3-Propyl-3-hexen-2-one	142	72 <sup>9</sup>			
33	3-Acetyl-furan	150	84 <sup>21</sup>			
34	3-Hydroxy-3-methyl-2-pentanone	150	73 <sup>50</sup>	1 4200		
35	1-Cyclopentyl-2-propanone (1-Cyclopentylacetone)	150	67 <sup>12</sup>			
37	<i>cis</i> -3-Hepten-2-one	152	70 <sup>15</sup>	1 4505 <sup>22</sup>	0 8555 <sup>22</sup>	
38	3-Hydroxy-3-methyl-2-heptanone	152	84 <sup>19</sup>			
39	<i>d</i> -2-Ethyl-5-methylcyclohexanone	152 4	83 4 <sup>18</sup>		0 9016 <sup>15</sup>	$[\alpha]_D +8.5$
40	5-Hydroxy-2-pentanone	155	86 <sup>10</sup>	1 4350 <sup>25</sup>		
41	3-Phenyl-2-butanone	158	107 <sup>22</sup>	1 5092		
42	3-Phenyl-3-hexen-5-one	158	138 <sup>19</sup>			
43	Dicyclopentyl ketone	162	112 <sup>12</sup>			
44	2-Ethylcyclohexanone	162 163	76 <sup>20</sup>	1 4522		2,4-Dinitrophenylhydrazone 162
45	2,3-Dimethyl-2-hepten-6-one	163	76 <sup>13</sup>			
46	3- <i>n</i> -Propylcyclohexanone	169	42 <sup>0 7</sup>	1 4530		
48	2-Cyclohexenone	172, 168	68 <sup>22</sup>	1 4879		2,4-Dinitrophenylhydrazone, 163 117
49	2-Chloropropiophenone (2-Chlorophenyl ethyl ketone)	173	106 <sup>12</sup>			
50	<i>d,l</i> -1-Acetyl-3-methylcyclohexanone	174-5	99 100 <sup>38</sup>			
51	3- <i>n</i> -Propyl-2-cyclohexenone	175	60 <sup>0 4</sup>	1 4876 <sup>25</sup>		2,4-Dinitrophenylhydrazone, 156
52	2-Bromoacetophenone	177	112 <sup>10</sup>			2,4-Dinitrophenylhydrazone, 189

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

a) Liquids 2) (Reduced pressure b.p. only) (Listed in order of increasing semicarbazone m.p.)\* (Continued)

No	Name	Semi-carbazone	Boiling point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Miscellaneous
53	2-Methyl-3-butenyl phenyl ketone	177	100 <sup>2 1</sup>	1.5223 <sup>25</sup>		
54	4-Methoxycyclohexanone	178	85 <sup>14</sup>	1.4560		2,4-Dinitrophenylhydrazide, 150
55	5,5-Dimethyl-3-hexen-2-one	178	79 <sup>40</sup>	1.4430		
56	Ethyl 2-methylstyryl ketone	178	152 <sup>14</sup>			
57	2-Bromopropiophenone (2-Bromophenyl ethyl ketone)	179	118 <sup>11</sup>			
58	3-Isopropyl-2-cyclohexenone	179	60 <sup>0 3</sup>	1.4842		2,4 Dinitrophenylhydrazide, 155
59	2-Ethylacetophenone	180	118 <sup>29</sup>	1.5249		
60	3-Pyridylacetone	185	123 <sup>1</sup>			
61	1-6-Isopropyl-3-cyclohexenone	185	98 100 <sup>10</sup>	1.484		[α] <sub>D</sub> <sup>18</sup> -64.5 2,4-Dinitrophenylhydrazide, 137-8 <i>p</i> -Nitrophenylhydrazide, 168-9
62	4- <i>n</i> -Butylacetophenone	185	141 <sup>14</sup>			
63	3-Phenyl-2-hexen-5-one	185	138 <sup>14</sup>			
64	3-Ethyl-2-cyclohexenone	186	57 <sup>0 9</sup>	1.4913		
65	3-Methyl-3-phenyl-2-butanone	186	77 <sup>15</sup>	1.5083		
66	2-Methyl-3-octen-5-one	187-8	68 78 <sup>24</sup>	1.4748		
67	4-Isopropylcyclohexanone	188, 188-9	91 <sup>13</sup>	1.4560		<i>p</i> -Nitrophenylhydrazide, 123-4
68	4,4,6-Trimethyl-2-cyclohexen-1-one	188, 185-7	73-5 <sup>13</sup>			
69	2-Acetyl-5-methylfuran	191	73 <sup>8</sup>			
71	3-Phenyl-2-pentanone		110 <sup>18</sup>	1.5051		
72	4-Phenylhexahydroacetophenone (Methyl 4-phenylcyclohexyl ketone)	191	121 <sup>1 2</sup>			
73	2,6,6-Trimethylcycloheptanone	191-2	85 5 <sup>12</sup>	1.4568 <sup>18</sup>	0.9095 <sup>18</sup>	2,4-Dinitrophenylhydrazide, 170
74	Acetyl phenyl carbinol	194	137			126 Oxime 113 <i>m p</i> 18, Oxime, 88
75	2-Tetralone	194	131 <sup>11</sup>	1.5555 <sup>25</sup>		Oxime, 78
76	3-Isopropylcyclohexanone	195	51 <sup>1</sup>	1.4540		
77	1-Propionylcyclohexene	195, 189	102 <sup>14</sup>			
78	α-Thienylacetone (1-(α-Thienyl)-2-propanone)	195	106 <sup>12</sup>	1.5366 <sup>14</sup>		
79	5,5-Dimethyl cyclohexen-3-one	195	88 5 <sup>32</sup>			H <sub>2</sub> SO <sub>4</sub> → red → vlt → col
80	2-Acetylbiphenyl	197	105 <sup>1</sup>			
81	3-Methyl-2-cyclohexen-1-one	199, 201	78 <sup>14</sup>	1.4945		2,4-Dinitrophenylhydrazide, 176 178
82	1-Acetyl-2,2-dimethylcyclohexene	201	118 <sup>49</sup>	1.4810 <sup>25</sup>		
83	1,1-Dimethyl-2-tetralone	204	96 <sup>0 5</sup>	1.538		
84	2-Methyl-1-tetralone	205, 195	138 <sup>16</sup>	1.5447		
85	6-Propionyltetralin	209	163 <sup>11</sup>	1.5508 <sup>29</sup>		
86	3-Methyl-2- <i>n</i> -propylcyclopentanone	210	58 <sup>2</sup>	1.4778		
87	4-Methyl-1-tetralone	211	111 <sup>1</sup>			
88	1-Acetylcyclopentene	211	74 <sup>12</sup>			
89	2-Acetyl-5-methylthiophene	217	83 <sup>2</sup>	1.5622		
90	1-Tetralone	217, yel, al	170 <sup>49</sup>			Oxime, 102, prisms, 88 9, needles, me al Oxime, 114
91	Neopentyl phenyl ketone	218	116 <sup>11</sup>	1.5078		
92	3-Methyl-2,5-hexanedione	220	71 <sup>10</sup>	1.4260		
93	<i>cis</i> -1-Decalone	220d	116 <sup>18</sup>	1.4939		
94	3-Acetylbiphenyl	223	138 <sup>1</sup>	1.6140 <sup>25</sup>		
95	1,2-Dimethyl cyclohexen-3-one	225d	118-9 <sup>12</sup>			
96	3-Chloroacetophenone	232	113 <sup>11</sup>	1.5494		
97	3-Bromoacetophenone	233	132 <sup>17</sup>	1.5755		
99	6-Acetyltetralin	234	156 <sup>10</sup>	1.5591 <sup>25</sup>		
100	2,3-Dimethyl-2-cyclopentenone	250	92 <sup>25</sup>	1.4830		

\*Derivative data given in order m p, crystal color, solvent from which crystallized



**TABLE X. ORGANIC DERIVATIVES OF KETONES**

**a) Liquids 2) (Reduced pressure b.p. only) (Listed in order of increasing semicarbazone m.p.)\* (Continued)**

No	Name	Semi carbazone	Boiling point °C	$n_D^{20}$	$D_4^{20}$	Miscellaneous
101	1-Ethyl-2-methyl-3-cyclohexenone	250	105 <sup>19</sup>			
102	3-Acetylthianaphthene	250	137 <sup>3</sup>			
103	2-Oxopropionaldehyde (Methylglyoxal, Pyruvic aldehyde)	<i>di</i> 254	52 <sup>12</sup>			<i>bis</i> -2,4-Dinitrophenylhydrazone 299-300, red, PhNO <sub>2</sub> , Dioxime 157, al

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point, °C	Boiling point °C	Semi-carbazone	2,4-Dinitrophenyl-hydrazone	p-Nitrophenyl-hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
1	<b>2-Aminoacetophenone</b>	20	250 2d	290d, al			108, al	109, subl, w	
2	<b>2-Dodecanone</b> ( <i>n</i> -Decyl methyl ketone)	20.5	246.7	122.3 dil al					$n_D^{20}$ 1.42855, $D_4^{20}$ 0.81982
3	<i>n</i> -Amyl phenyl ketone ( <i>n</i> -Pentyl phenyl ketone)	24.7	265.2	131.5, 50% al 133 (cor)	168 (cor), ac a				$n_D^{25}$ 1.50272
4	<b>3,5-Dichloroacetophenone</b>	26	134.6 <sup>17</sup>					138	
5	<b>Benzyl methyl ketone</b> (Phenyl-acetone)	27	216.5 (cor)	199.9.5, al, 188	156	145	86.7 lgr 83	68.70	$n_D^{20}$ 1.5168
6	<b>4-Methylacetophenone</b>	28	226	204.5, al, 197	260.4 (cor), scar, ac a	198	97, al	87-8, pet eth	$n_D^{20}$ 1.5348, $D_4^{20}$ 1.003
7	<b>2-Hydroxyacetophenone</b>	28	215	210	210.12 212.3		110	118	
8	<b>Phorone</b> (Di-isopropylidene-acetone)	28, yel-gr	198	221, w 186	118			48	Tetrabromide, 88.9, al
9	<b>2-Tridecanone</b> (Methyl <i>n</i> -undecyl ketone <i>n</i> -Hendecyl methyl ketone)	28	263	123, al, 126, 117	69, or -yel	101-2		56.7, al-pet eth	$n_D^{20}$ 1.43175
10	<b>Furfuralacetophenone</b>	29, yel-red	317d		169, scar				
11	<b>Ethyl 2-furyl ketone</b>	30, 28	183	189					
12	<b>4-Cyclohexylcyclohexanone</b>	30-31 29.2	100 <sup>9</sup> 1	216	137			101.2, 104.5 78	
13	<b>2-(1'-Hydroxycyclopentyl)-cyclopentanone</b>	31	99 <sup>3</sup>						
14	<b>7-Tridecanone</b> (Di- <i>n</i> -hexyl ketone)	31.2	255, 264			96			
15	<b>2-Acetyl furan</b> (2-Furyl methyl ketone)	32, 33	169-73	150, me al, 148	220	185.6, red, w-al	86, yel, w-al	104, eth-pet eth, 92	$n_D^{20}$ 1.5017, $D_4^{20}$ 1.098
16	<b>Levulinic acid</b> (3-Acetyl propionic acid)	33	245.6		206 (cor), or -yel, ac a	174.5	108, bz	45-6	
17	<b>2-Tetradecanone</b> ( <i>n</i> -Dodecyl methyl ketone)	33-4, dil al		115.6, al					
18	<b>Methyl 1-naphthyl ketone</b> (1-Acetylnaphthalene)	34	302	222.5.4			146	136	$n_D^{20}$ 1.6257, Picrate, 116, yel
19	<b>1,3-Diphenyl-2-propanone</b> (1,3-Diphenylacetone Dibenzyl ketone)	34, 35, 30	330	145.6, abs al, 125-6, dil al	100		121, al, 128.9	125, 123	
20	<b>2,2,6,6-Tetramethyl-4-piperidone</b>	34.9, red, dry eth, 58 (monohyd), eth	205-6	219.20, al				153 al	
21	<b>4-Chloropropiophenone</b>	36-35	118 <sup>2</sup>	177, 175.6				62-3	
22	<b>2-Phenylcyclopentanone</b>	37	126-7 <sup>10</sup>	218d					
23	<b>Furfuralacetone</b>	38, 39	116 <sup>10</sup>		241 (cor)		131-2, al		
24	<b>4-Methoxyacetophenone</b>	38, 37	258	197.8, dil al	220 (cor), red, 231.8 (cor)	195-5.5, or, al	142, yel, al	86-7, wh, pet eth	
25	<b>1-Phenyl-1-hepten-3-one</b> ( <i>n</i> -Butyl styryl ketone)	38.9, 40	159-67 <sup>11</sup>				98, yel		Dimer, 175-6

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semi-carbazone	2,4-Di-nitrophenyl-hydrazone	p Nitro-phenyl-hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
26	4,4-Dimethylcyclohexanone	38 41	73 <sup>14</sup>	204			106 7		n <sub>D</sub> <sup>20</sup> 1 4537 D <sub>4</sub> <sup>20</sup> 0 932
27	3,4-Methylenedioxypropio-phenone (Propiopiperone)	39		187 8			97	104	
28	2-Hydroxybenzophenone	39, w -al 153	250 <sup>160</sup>				155, al	syn 141, bz anti 143, bz 145 8, dil al fu sion → 130	
29	2-Methoxybenzophenone (2-Anisyl phenyl ketone)	39							
30	3-Bromopropiophenone	40		183					
31	Benzalacetone	41	212	187	227, 223	166	157	115	Thiosemicarbazone, 148
32	1-Indanone (α-Hydrindone)	42, 38	241 2 <sup>739</sup>	233 239	258	234 5, ac a	130 1 134 5 me al 124 8	146 144 bz pet eth	
33	2,4-Dichloroacetophenone	42	235 40	208				152	n <sub>D</sub> <sup>20</sup> 1 5640
34	3-Aminopropiophenone	42, yel	168 9 <sup>15</sup>	196 7				112 112 3	N-p Toluenesulfonyl deriv 97 al
35	2-Bromobenzophenone	42	345					133	
36	8-Pentadecanone (Di-n-heptyl ketone)	42	178					120	
37	4-Phenyl-3-buten-2-one (Methyl styryl ketone)	42	262	186, al , 198, 142	227, red, ac a 223, or - red, al	165 7, red, al	156 7 yel , al , 159	115 6, 60° al 87	H <sub>2</sub> SO <sub>4</sub> → or -red
38	3-Chlorobenzyl phenyl ketone	43						102	
39	8-Acetylguanine	43 5	116°		253				
40	2-Benzoylfuran (2-Furyl phenyl ketone)	44	150 <sup>3</sup>					122	
41	1,3-Dichloro-2-propanone (1,3-Dichloroacetone)	45	175, 173						n <sub>D</sub> <sup>20</sup> 1 47144, D <sub>4</sub> <sup>20</sup> 1 3826
42	2-Acetylquinoline	46					54		
43	3-Chloropropiophenone	46		179-80					
44	4-Bromopropiophenone	46	140 <sup>2</sup>	171				90 1	
45	Phenyl n-undecyl ketone (n-Hendecyl phenyl ketone Laurophenone)	47, 44		94 5 95				63 63 5	
46	2-Aminopropiophenone	47, pet eth		190d , al				88 9, w	Hydrochloride, 184 5 N-Acetyl 70 1
47	Benzophenone	48, 49	306 (cor )	164-5, al , 167	238 9, or - yel , ac a , 229	154 5, yel , al , 144, red, al	137 8, al	142 3, me al , 144 140	D <sub>20</sub> <sup>20</sup> 1 0976
48	2,4,6-Heptanetrione (Diacyl-acetone)	49	121 <sup>10</sup>	mono 203			di 142	2,6-di 68 5	n <sub>D</sub> <sup>20</sup> 1 4930, D <sub>4</sub> <sup>20</sup> 1 0681
49	5-Phenoxy-2-pentanone (Methyl 3-phenoxypropyl ketone)	50	121 <sup>2</sup>	108 10	110				
50	9-Heptadecanone (Di-n-octyl ketone)	50-50 5	250-3			54		111 2	
51	Phenacyl bromide (ω-Bromo-acetophenone)	50, 51		146	212-3, yel , or			89 5, 97	
52	4-Bromoacetophenone	51, 50 5	225	208	230, 237 (cor )		126	128, 129	
53	3-Bromophenacyl bromide	51, lgr	174 <sup>14</sup>	163-4d , al					
54	Ethynyl phenyl ketone	51			214				

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semi-carbazone	2,4-Dinitrophenylhydrazone	p-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Miscellaneous
55	3,4-Dimethoxyacetophenone (Acetoveratrone)	51, w -al	286-8	218, w al	206-7	227	131	140, w -al	
56	Diphenylacetoin	52		169					4-Nitrobenzoate 84
57	Methyl 2-naphthyl ketone (2-Acetylnaphthalene)	53 4, al , 56	301	234 5 237	262d , red, ac a		176-7, 171	149, 145 6	Picrate, 82
58	Chloromethyl 2-phenylethyl ketone	54	244 5	156	147, 146			89	
59	2-Furyl-2-thienylmethane	55 5	195 <sup>6</sup>						Cu salt, 274
60	Phenyl 2-thienyl ketone (2-Benzoylthiophene)	56	300	195-7				93	
61	2-Nonadecanone (n-Heptadecyl methyl ketone)	56		124-5 125 5 6				77	
62	4-n-Caproylresorcinol (2,4-Dihydroxy-n-caproylbenzene)	56 7	243 5d					190-1d , 50% al	
63	2,2-Dichlorobenzoin	57							
64	3-Propionylphenanthrene	57						53 6 4 7	Picrate, 113
65	9-Propionylphenanthrene	57							Picrate, 107
66	Benzalacetophenone (Phenyl styryl ketone Chalcone)	58, pa yel al 57 8	345	α 168, β 170, γ 179-80d	244d , or - red, ac a , 245 (cor )		120	140 68	Picrate, 93 7, Dimers, 124, 178, 195, 225 6
67	2-Indanone	58 58 9		218, 212-15 (dec )		232 (dec )		155	
68	Phenacyl chloride (ω-Chloroacetophenone)	59	244	156, 149	213 4d 214 5d			89	
69	3-Phenyl-2,4-pentanedione	60	134 <sup>20</sup>						Cu salt, 224
70	Mesitylacetone	60	130 <sup>10</sup>	205, 197					
71	Ethyl 2-naphthyl ketone	60	312 4	202				133, w -al	
72	Difurfuralacetone	60, yel					121-2		
73	Desoxybenzoin (Benzyl phenyl ketone)	60, al	321 (cor )	148, dil al	204 (cor ), or	163, red-br , 160	116, yel , al	98, al	
74	4-Methylbenzophenone (Phenyl 4-tolyl ketone)	60, 55	326 (cor )	121-2, al	202 4 (cor ), 199-200, or		109, wh , ac a	154, less soluble in w-ac a , 115, more soluble in w-ac a	
75	1-Phenyl-1,3-butanedione (Benzoylacetone Methyl phenacyl ketone)	61	261-2		151, pa yel , al	100-1, me al	150-3		
76	1,1-Diphenylacetone	61, al		170			131, bz	165	
77	2,4'-Dibromobenzophenone	62, pet eth	381-4 sl d					141-2	
78	5-Isopropyl-1,3-cyclohexanedione	62							
79	Benzyl 3-chlorophenyl ketone	62						120	
80	4-Methoxybenzophenone (4-Anisyl phenyl ketone)	62 4 al	354		180, dk or	198-9, al	132, 90	α 140 1, 137-8, β 115 6	
81	2-Phenylcyclohexanone	63, al , 60	160 <sup>15</sup>	190	139			169	
82	4-Methoxybenzil	63						124	
83	1-Acetyl-2-hydroxynaphthalene	64							Benzoate, 85 6, pyr
84	11-Heneicosanone (Di-n-decyl ketone)	64, w -al						27 5	
85	Benzoylformic acid (Phenylglyoxylic acid)	66	147 51 <sup>12</sup>		196 7d (cor ), yel			α 127, eth , β 145d , w 105	Thiosemicarbazone, 188 9 (cor ), yel
86	2,2-Dimethylbenzophenone (Di-2-tolyl ketone)	67			190				

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semi-carbazone	2,4-Di-nitrophenyl-hydrazone	p-Nitro-phenyl hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
87	<b>1,5-Diphenyl-1,5-pentanedione</b> (1,3-Dibenzoylpropane)	67.5, 62-3						di 165 6d	
88	<b>3,5-Dibromoacetophenone</b>	68, al, 65	198 <sup>15</sup>	268d, w - ac a			109-10, yel, al		
89	<b>Cinnamalacetone</b>	68, eth		186, yel, al	222.3, vlt -red, ac a, 218-20, br -red, chl -me al		180, yel, al	153, al, 152	
90	<b>Benzoyl-2-furoylmethane</b>	68	169 <sup>3</sup>						Cu salt, 248
91	<b>12-Tricosanone</b> (Di-n-undecyl ketone Di-n-hendecyl ketone, Laurone)	69.5		179				39.40, al	
92	<b>Diphenyl triketone</b>	70, 69, yel, lgr							Heating with excess phenylhydrazine → 4 Benzene-azo-1,3,5 tri-phenylpyrazole, 156.7 yel -red, al
93	<b>2-Chlorobenzyl phenyl ketone</b>	71						86	
94	<b>Dihydroxyacetone</b>	72			277.8	160		84	Diacetate, 48 Dibenzoate, 120.5, Dimer 78.81 Picrate, 125.6
95	<b>3-Acetylphenanthrene</b>	72		230				193.4	
96	<b>4-Methoxybenzalacetone</b> (Anisalacetone)	73, me al			229 (cor), red, ac a			119.20	
97	<b>Benzylacetophenone</b>	73		144				87	
98	<b>Phenoxymethyl phenyl ketone</b> (α Phenoxyacetophenone)	74	187 <sup>8</sup>	187					
99	<b>9-Acetylphenanthrene</b>	74	170 <sup>1</sup>	201				154-5	Picrate, 107.8
100	<b>1-Naphthyl phenyl ketone</b>	75.5-6.0	225 <sup>15</sup>	385	α 246.7, red, β 243.4, or, mixt 220			161	
101	<b>9-Acetylfluorene</b>	75.5					139		
102	<b>2-Benzofuryl methyl ketone</b>	76, 72	136 <sup>11</sup>	207			154		
103	<b>Benzyl 4-methoxyphenyl ketone</b>	77						118	
104	<b>4-Methoxybenzalacetophenone</b> (Anisalacetophenone 4-Methoxychalcone)	77, yel, al			α 168, al, β 190, al				Picrate, 87, or
105	<b>2-Naphthoxyacetone</b>	78, 77			203		154	123	
106	<b>4-Phenylcyclohexanone</b>	78			212, 229d, al			110	
107	<b>Benzoyl-2-thenoylmethane</b>	78	201 <sup>4</sup>						Cu salt, 278
108	<b>4-Chlorobenzophenone</b>	78				185	106	β 105-6	
109	<b>1,4-Cyclohexanedione</b>	79	132 <sup>20</sup>	mono 221.2, di 231		240		188	
110	<b>Di-n-tridecyl ketone</b> (Myristone)	79						57	
111	<b>Phenacyl phenyl ketone</b> (Di-benzoylmethane, ω-Benzoyl-acetophenone)	79 keto 81, enol 78, al		205			mono 105	mono 165	Dibromo deriv, 94-5, eth
112	<b>3-Nitroacetophenone</b>	81		257	228		128, 135	132	
113	<b>4-Bromobenzophenone</b>	82		350	230		126	α 116-7, β 110-1	
114	<b>1-Benzoylpropionic acid</b>	82-3d					100-4, br, bz		

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semi carbazone	2,4-Dinitrophenylhydrazone	p-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Miscellaneous
115	Fluorenone	83, yel, bz	341.5		283.4	269	151.2, yel, al	195.6 (cor)	
116	4-Iodoacetophenone	85, eth	153 <sup>18</sup>						
117	Di-n-Heptadecyl ketone	88.5, lgr, 89						67.62.3	
118	4,4'-Dimethylbenzophenone (Di 4-tolyl ketone)	95, al	335	143.4	218.9		100, yel, al	163, al	Hydrazone, 108.10
119	Benzil (Dibenzoyl)	95, yel	347	mono 174-5 d, di 243.4d, al	di 189, yel, al, 185	mono 192.3, dk or, ac a, di 290, yel, pyr-eth	mono 134, yel, al, di 235, chl rapid htng	$\alpha$ mono 137.8, 140, bz, di 237	
120	$\beta,\beta$ -Diphenylpropiophenone	96-92						133	
121	3-Hydroxyacetophenone	96, 95	296	189.91	261				
122	4-Chlorophenacyl bromide	96-8							Acetate, 72
123	2,3-Dihydroxyacetophenone (3-Acetylcatechol)	97.8, dk yel, bz-lgr		166.7				96.7	Diacetate 109, bz Di-Me eth, b p 143.4 <sup>14</sup> 143.4 <sup>14</sup>
124	2-Naphthylglyoxal	98, (hyd), w 109	183 <sup>20</sup>						Diacetate, 150, bz-pet eth osazone 184
125	3-Aminoacetophenone	98-9, pa yel, al		196d, w				192.4, w-al	Hydrazone, 98, al
126	2-Benzoylacrylic acid	99 (anh) 64 (mono hyd)		190			197	168d	Hydrazone, 185.6, al
127	Di-2-thenylmethane	100							Cu salt, 263
128	Di-1-naphthyl ketone	100						200	Picrate 121.5.2.0
129	1,3-Dibenzoylbenzene	101.2, al						mono 201, di 70-3	
130	2-Acetyl-1-hydroxynaphthalene	102, gr-yel, al, 98, yel, bz	325 sl d	245.50, pa yel			136.7, wh, dil al	168.9	Acetate, 107.5, Benzoate, 128, al
131	Cinnamacetophenone	102, yel, al			222, red, ac a, 218.9d	$\alpha$ 135, al			
132	1,3-Cyclohexanedione	104						156	
133	4-Tolil (4,4'-Dimethylbenzil)	104.5						225	
134	2-Propionylphenanthrene	105, 104							Picrate, 107
135	2-Aminobenzophenone	105-6, pa yel, al						156, alk-stab, 127, a-stab	
136	Benzoylnitromethane	106					105.5.5, yel, al	96, w	
137	4-Aminoacetophenone	106, w	294	250, yel al	266.7, 263			147.8, al	4 Toluenesulfonamide, 203
138	Benzalacenaphthenone	107, yel, w-al						48	
139	Benzyl 4-chlorophenyl ketone	108						123	
140	4-Bromophenacyl bromide	108.9						115	Acetate, 72
141	4-Hydroxyacetophenone (4-Acetylphenol)	109		199	210, br, al		151, wh $\rightarrow$ yel	145, 143.4, bz	Acetate, 54, Benzoate, 134.5, al
142	trans-1,2-Dibenzoyl ethylene	110						211	
143	Piperonalacetone	110-1, pa yel		$\alpha$ 217, al, $\beta$ 168, bz			163	186, al	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semi-carbazone	2,4-Dinitrophenyl-hydrazone	p-Nitrophenyl-hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
144	2-Acetyldibenzothiophene	112		235					
145	1,5-Diphenyl-3-pentadienone (Dibenzalacetone)	112, 111		187-90, al	180, red, ac a	173, yel, bz	152 3, 147 8, yel, al	142 4	Picrate, 114
146	4,4'-Dimethoxybenzoin (Anisoin)	113, dil al		185 (cor), w-al					Acetate, 94-5, al -pet eth
147	1,4-Diacetylbenzene	114	130 <sup>3</sup>					240	
148	3,4-Dihydroxyacetophenone (4-Acetylcatechol)	116, w	127 33 <sup>11</sup>					184d, et ac	3 4-Diacetate, 91
149	3-Hydroxybenzophenone	116, al						syn 76, anti 126, bz	
150	α-Hydroxyacetophenone (Phenacyl alcohol, Benzoyl carbinol)	117 8	118 <sup>11</sup>	146 6 5, al			112, lgr - eth	70	Acetate, 49, eth, Benzoate, 118, dil al
151	7-Acenaphthenone	121 (cor), al					90, dk, al	175, al, 183 4, bz, di 222d	Picrate, 113
152	4-Phenylacetophenone (4-Acetyl-biphenyl, Methyl 4-xenyl ketone)	121, al	325-7		241 5-2, red-or			186-7, al	
153	Piperonalacetophenone (3,4-Methylenedioxychalcone)	122, yel, al		α 203-5, abs al					Dibromide, 152, bz -lgr (l 1), Picrate, 126-8
154	9-Hydroxyxanthene (Xanthidrol)	122-4d							Heat → Dixanthyl ether, 219, Dixanthyl, 204, lgr
155	4-Aminobenzophenone	124, w -al						168, al, 127, w -al	Hydrazone, 139-40, yel, al
156	4-Phenylphenacyl bromide	124 5							Acetate, 111
157	2-Naphthoin	126						172	
158	4-Phenylphenacyl chloride	126-7							Acetate, 111
159	Vanillalacetone (4-Hydroxy-3-methoxystyryl methyl ketone)	129, yel, al			230 (cor), red		127-8, yel		
160	Dianisalacetone	129, yel, bz -pet eth			82-3			147 8	
161	4,4'-Dimethoxybenzil (Anisil)	133, yel		di 254 5, dil ac a				mono 133, syn di 217, anti, di 195, bz	Dihydrazone, 118
162	d,l-Benzoin	133, al, 129	344	α 205-6, w	245, yel, al, 234		α 158-9, bz -lgr, β 106	α 151 2, bz, β 99	Acetate, 83, al, Benzoate, 124 5, 75% al
163	cis-1,2-Dibenzoyl ethylene	134						di 210 ld	
164	3,4,5-Tribromoacetophenone	134 5, al		265d, ac a			129-34d, yel, pet eth		
165	4-Hydroxybenzophenone (4-Benzoylphenol)	134 5, w		194, bz	242 4 (cor), or		144, pet eth	81, Heat → 152	Acetate, 81, al Benzoate, 94 5, 115
166	1-Furoin	135, 138-9 (cor)			216 7, or -red, al		79-81, lgr -bz	α 161, al, β 102, pa yel, eth	Acetate, 76-7, Benzoate, 92 3
167	Mesityl phenyl ketone	137			232				
168	4-Chlorobenzyl phenyl ketone	138						96	

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point °C	Semi carbazone	2,4-Di nitrophenyl-hydrazone	p-Nitro-phenyl hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
169	$\alpha$ -Anisal- $\alpha'$ -cinnamalacetone	139, red, al					Pyrazo- line, 155 6, yel, al		Dibromide, 139-40, CS <sub>2</sub> , Tetrabromide, 155 6, CS <sub>2</sub>
170	4-Aminopropiophenone	140, w						153, al	N-Acetyl deriv 161, w
171	3,3'-Dibromobenzophenone	141						181 2d	
172	2-Acetylphenanthrene	143		260			187 8		
173	Dicinnamalacetone	144, yel, abs al			195 7 (cor), dk red dt 265		166, yel, al		Light → d
174	1,2-Dibenzoylthane	147					mono 116, di 179	204	
175	2,4-Dihydroxyacetophenone (Resacetophenone)	147, 144		218, 214 20d	206 8		156 8	202 3	2,4-Diacetate, 38 2,4 Dibenzoate, 81
176	3,5-Dihydroxyacetophenone	147 8, w		205 6, al		236 7, red, w - ac a			3,5-Diacetate, 91-2, lgr
177	4,4'-Dichlorobenzophenone	147-8			238-40			135	
178	1,2-Dibenzoylbenzene	148						mono 150	
179	9-Benzoylanthracene (9-Anthra-phenone)	148, yel, bz							H <sub>2</sub> SO <sub>4</sub> → brief blue color
180	4-Hydroxypropiophenone	148			229				
181	5,5-Dimethyl-1,3-cyclohexanedione (Methone Dimedone)	148 9						mono 115 di 176	
182	2,3,4,2'-Tetrahydroxybenzo-phenone	149 (anh), 100 (hyd), yel, w							2,3,4,2'-Tetraacetate, 118, al
183	Anthrone	154, ac a							Al sol → bl fluorescence
184	1,4-Dibenzoylbenzene	161, al						mono 212-3, di 235	
185	Furil (2,2'-Bifuroyl)	165, yel, bz					mono 82 3, yel, di 184, yel, lgr	$\alpha$ , mono 106, $\beta$ , mono 97-8, $\alpha$ , di 100, 166, $\beta$ , di 188 90	
186	Benzanthrone	170, yel, al							H <sub>2</sub> SO <sub>4</sub> → or -red sol, gr fluorescence
187	Quinhydrone	171, dk gr, subl					152	161	
188	2,3,4-Trihydroxyacetophenone (Gallacetophenone)	172, w		225, rapid htng				162 3	2,3,4-Triacetate, 85 Picrate, 133
189	Xanthone (Diphenylene ketone oxide)	174	350				152	161	
190	4,4'-Bis(dimethylamino)benzo-phenone	174					174 5	233	Hydrazone, 150, Picrate, 156
191	4,4'-Dibromobenzophenone	177	395					150-2	Hydrazone, 92-4
192	d,l-Camphor	di 178, d 179	209, 205	247-8d (cor), 236-7, al	d, l 164, d 177, or, al >320, red, PhNO <sub>2</sub>	217	233	d 118 9	d $[\alpha]_D^{20}$ + 44, Hydrazone, 55
193	3-Acetylidazole	182, yel, ac a						222, bz - al	N-Acetyl deriv, 123, ac a
194	3,4,5-Trihydroxyacetophenone	187-8, w		216-7, al		260d, red, w-ac a			3,4,5-Triacetate, 111-2, lgr

\*Derivative data given in order m p, crystal color, solvent from which crystallized



**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

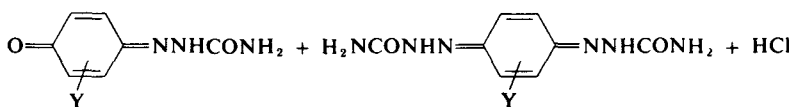
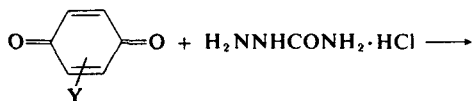
No	Name	Melting point °C	Boiling point, °C	Semi carbazone	2,4-Di nitrophenyl hydrazone	p Nitro phenyl hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
195	3-Acetylimidole	190						144	7, w N-Acetyl deriv, 151, subl, pet eth -bz, Picrate, 183, yel, pet eth Diacetyl deriv, 165
196	2,5,2',6'-Tetrahydroxybenzophenone	200							6, bz 2,5,2',6'-Tetraacetate, 118
197	2,5-Dihydroxyacetophenone (Quinacetophenone)	202				215		149	50, tol 2,5-Diacetate, 68, ac a
198	2,4,5-Trihydroxyacetophenone	206							7, red 2,4,5-Triacetate 165
199	2,3,5-Trihydroxyacetophenone	206				241			6, bz 2,3,5-Triacetate, 106
200	2,4,6-Trihydroxyacetophenone (Phloracetophenone)	219							7, lgr 2,4,6-Triacetate, 103, 2,4,6-Tribenzoate, 117
201	2,3-(3',4',5'-Triphenylcyclopentadieno)-indone	222					246-7		
202	3,4,3'4'-Tetrahydroxybenzophenone	227						145	al
203	Ninhydrin (Triketohydrindene hydrate)	243, 241					di 207	201	8, or -red, al Warm aqueous sol of α-amino acids → intense bl, vlt, etc At 125-30, loses w, turns red N-Benzyl deriv, 188
204	Phenacridone	304							9, yel, ac a yel, al

\*Derivative data given in order m p, crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE XI

The derivatives of quinones are usually similar to those of ketones. Therefore, for directions and examples for their preparation see explanations and references to Tables 9 and 10, pages 141, 142, 143

The derivatives listed as *phenylhydrazones*, *p-nitrophenylhydrazones* and *2,4-dinitrophenylhydrazones* of quinones in most cases are not real substituted phenylhydrazones, but either addition compounds or hydroxy derivatives of variously substituted aromatic azo compounds

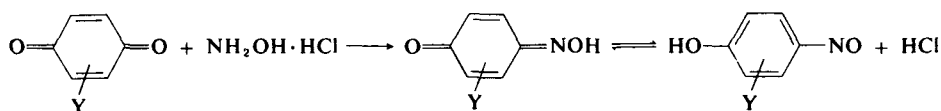
**Semicarbazone \***

Monosemicarbazone

Disemicarbazone

From the quinone with semicarbazide hydrochloride in water

For directions and examples see Linstead, p 30, Vogel, p 749

**Oxime \***

Monooxime

Substituted *p*-nitrosophenol

From the quinone with hydroxylamine hydrochloride in water

For directions and examples see Linstead, p 30

\*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives

**TABLE XI. ORGANIC DERIVATIVES OF QUINONES**  
(Listed in order of increasing m.p.)\*

No	Name	Melting point, °C	Boiling point, °C	Semi carbazone	2,4 Di nitrophenyl hydrazone	p-Nitro-phenyl-hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
1	<b>2,3,5-Trimethyl-1,4-benzoquinone</b>	32, yel, eth		252 3 d, yel				1-mono 181 2, yel, al 4-mono 134, yel	
2	<b>2-Isopropyl-5-methyl-1,4-benzoquinone (Thymoquinone)</b>	45 5, or - yel	232	mono 201 2d, yel, al, di 237, yel	mono 179 80, dk red, al		93	1-mono 160 2, pa yel chl	
3	<b>2,3-Dimethyl-1,4-benzoquinone (o-Xylo-p quinone)</b>	55 (subl), yel						mono 166, yel	
4	<b>2-Bromo-1,4-benzoquinone</b>	56						1-mono 184, or 4-mono 196	
5	<b>2-Chloro-1,4-benzoquinone</b>	57, yel - red		4-mono 185d				1-mono 184, pa grn -yel, 4-mono 148d	
6	<b>2-Methyl-1,4-benzoquinone (p-Toluquinone)</b>	67 6 68 4		4-mono 178 9, yel, al di 240d, or -red	di 269, PhNO <sub>2</sub>		130	mono 134 5d w, di 220d, yel -wh	
7	<b>2,6-Dimethyl-1,4-benzoquinone (m-Xylo-p-quinone)</b>	68 71, yel						1-mono 175, yel, al -w 4 mono 170 1, yel bz di 128, br	
8	<b>4-Chloro-1,2-benzoquinone</b>	78 pa yel -red, hexane							
9	<b>2,5-Dimethyl-1,4-naphthoquinone</b>	94 yel me al					mono 226, red, ac a		
10	<b>Dunnione</b>	98 9, or - red, w		mono 232 3, w -me al	266 8, or				[α] <sub>D</sub> <sup>20</sup> +310° in chl
11	<b>2-Methyl-1,4-naphthoquinone</b>	106, yel, me al			4-mono 299d			mono 160, di 166-8	Benzoyl chloride + Zn dust → 1 4-dibenzyloxy-2-methylnaphthalene, 180 0-0 5, col, al
12	<b>Quinone (1,4-Benzoquinone)</b>	116, yel 113		mono 166, yel, 165-6d, red, 178, di 243d, red	mono 185 6, br, al, di 231		152	240	Picrate, 79, Quinhydrone, 171
13	<b>2-Chloro-1,4-naphthoquinone</b>	117, yel, w						4-mono 200d 198, pa yel, bz	
14	<b>1,4-Naphthoquinone (α-Naphthoquinone)</b>	117 8, yel, al		mono 247, grn -yel, ac a	mono 278, yel, pyr	mono 277 9, or -red, PhNO <sub>2</sub>	mono 205-6d, dk vlt, bz		

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XI. ORGANIC DERIVATIVES OF QUINONES**  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point, °C	Semi-carbazone	2,4 Dinitro-phenyl-hydrazone	p-Nitro-phenyl-hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
15	<b>2,5-Dimethyl-1,4-benzoquinone</b> ( <i>p</i> -Xylo- <i>p</i> -quinone)	125, yel, al					122 4, yel, 154 5, or	<i>mono</i> 168, yel, w, <i>di</i> 272, yel, al, 254	Monobenzoylphenyl-hydrazone, 122 4, yel, lgr
16	<b>2,6-Dibromo-1,4-benzoquinone</b>	131, yel, al		<i>4-mono</i> 225d, yel, al				<i>4-mono</i> 170d, br	
17	<b>2,6-Diphenyl-1,4-benzoquinone</b>	137 8, red						242-4d	
18	<b>2,5-Dihydroxy-3-<i>n</i>-dodecyl-1,4-benzoquinone</b> (Embelin)	143, or -red, eth -bz		<i>di</i> 236			<i>di</i> 189 90	<i>tetra</i> 175	Diacetate, 54 Dibenzoate, 97-8
19	<b>1,2-Naphthoquinone</b> ( $\beta$ -Naphthoquinone)	145 7d, red, eth, 120		<i>1-mono</i> 184d, yel, al		<i>1-mono</i> 250 1, <i>2-mono</i> 236, dk red, ac a	<i>2-mono</i> 138, dk red, al	<i>1-mono</i> 109 5, <i>2-mono</i> 162-4d, <i>di</i> 169, yel, al	
20	<b>3,7-Dimethyl-1,2-naphthoquinone</b>	151 2, red, al						<i>2-mono</i> 222d, or	
21	<b>5-Hydroxy-1,4-naphthoquinone</b> (Juglone)	153 4, or, bz						<i>mono</i> 167 0, 7 5, red, ac a, <i>di</i> 225 (exp), dk br, ac a	Acetate, 154-5
22	<b>3-Chloro-1,2-naphthoquinone</b>	172, red, chl						<i>1-mono</i> 167 8, or	
23	<b>1,8-Dihydroxy-2-methyl-9,10-anthraquinone</b> (2-Methylchrysazin)	175							Diacetate, 205
24	<b>2-Methyl-9,10-anthraquinone</b>	177 9, 177, pa yel							Diacetate, 217, pa yel, ac a
25	<b>3,5-Dihydroxy-2-methyl-1,4-naphthoquinone</b> (Droserone)	181, pa yel, al					<i>di</i> 151		Diacetate, 119, me al
26	<b>2,3,4-Trihydroxy-9,10-phenanthraquinone</b>	185d, br -red		<i>mono</i> 270d, br -red, al					Phenazine, 255d, br, al
27	<b>6-Bromo-1,4-dihydroxy-9,10-anthraquinone</b> (6-Bromo-quinizarin)	185 5, red-br, bz							Di Me eth, 176 5, or -yel, al, Diacetate, 220 5, yel, al
28	<b>1,2-Anthraquinone</b>	185 90d, or -br						<i>1-mono</i> 188d, or -br, <i>2-mono</i> 200d, or -br	
29	<b>4-Chloro-1,2-naphthoquinone</b>	188, red br, bz						<i>2-mono</i> 157, pa yel	
30	<b>7-Isopropyl-1-methyl-9,10-phenanthraquinone</b> (Retenequinone)	197, or, al		<i>mono</i> 200, yel, pyr		<i>mono</i> 222 3, red, ac a	<i>mono</i> 160, or, bz -al	<i>mono</i> 128 5, 130 1 (cor), yel, al	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XI. ORGANIC DERIVATIVES OF QUINONES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semi-carbazone	2,4-Dinitro-phenyl-hydrazone	p-Nitro-phenyl-hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
31	Camphorquinone	199, yel, dil al		3 mono (α) 236d, al	mono 36, di 190	239	183 90, pa yel, al, 170	mono α 153 β 114 5, di (four forms) α 201d, β 248d, γ 136 δ 194d	3-p-Bromophenylhydrazone, 215 6, ac a, Hydrazone, 182
32	1-Hydroxy-9,10-anthraquinone	200, or -red, al, 193	subl						Acetate, 176 9, yel, al
33	1,4-Dihydroxy-9,10-anthraquinone (Quinizarin)	200 2 (cor), red, ac a, 195							Diacetate, 207 8, yel, pyr, 200-1, yel, ac anh
34	9,10-Phenanthraquinone	206 7 5, or -yel, 208, or	>360, subl → or -red	mono 220d	mono 312-3d, dk red	mono 245, red, xyl	mono 165, dk red, al	mono 158, grn -yel, al, di 202d 233 br, turns dark at 205	Conc H <sub>2</sub> SO <sub>4</sub> → dull grn
35	1,4-Anthraquinone	218d, yel, turns dark at 200 10							Triacetate, 187, yel, Conc H <sub>2</sub> SO <sub>4</sub> → red
36	4-Chloro-1,2,3-trihydroxy-9,10-anthraquinone	233, yel							
37	2-Bromo-9,10-phenanthraquinone	233 4, red-yel, ac a						mono 163 4, or	
38	1-Bromo-9,10-phenanthraquinone	233-4, yel						mono 213d	
39	Chrysoquinone (Chrysenquinone)	239 5, red						mono 161, or	Conc H <sub>2</sub> SO <sub>4</sub> → bl
40	1,2,8-Trihydroxy-9,10-anthraquinone (2-Hydroxychryszazin)	239 40, red, ac a							Triacetate, 224, yel 2-Me eth, 220 or, chl-me al, 2,8-Di-Me eth, 193, br -yel, chl-me al, 1,2,8-Tri-Me eth, 157, yel, me al
41	1-Amino-9,10-anthraquinone	251, or -red							N-Acetyl, 218, or -red, N-Benzoyl, 255, grn, N-p-Toluensulfonyl, 228 9
42	3-Amino-9,10-phenanthraquinone	254, dk red-br, al						mono 247d, red-br	
43	1,2,4-Trihydroxy-9,10-anthraquinone	259, dk red, abs al							2-Me eth 232 3, red, bz, 2,4-Di-Me eth 186-9, or, 2-Acetate, 179 80, or, al Triacetate, 198-200 (sinters 193), pa yel
44	Acenaphthenequinone	261 (cor), yel, ac a		mono 192-3, ac a, di 271, al		mono 247, or -red, ac a	mono 179, or -red, al, di 219, dk yel, al	mono 230, dil al, 220d	

\* Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XI. ORGANIC DERIVATIVES OF QUINONES**  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semi-carbazone	2,4-Dinitro-phenyl-hydrazone	p-Nitro-phenyl-hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
45	<b>1,3-Dihydroxy-4-methyl-9,10-anthraquinone</b> (4-Methylpurpuroxanthin)	265 6, or , bz							Di-Me eth , 162, yel , chl , Diacetate, 181-2, yel , ac a
46	<b>2-Bromo-1,4-dihydroxy-9,10-anthraquinone</b> (2-Bromoquinizarin)	265 8, br - red							Diacetate, 226-9, yel
47	<b>3-Bromo-9,10-phenanthraquinone</b>	268 dk - yel , ac a		<i>mono</i> 242d			<i>mono</i> 177, red	<i>mono</i> 198, <i>di</i> 212d , grn	
48	<b>Aceanthrenequinone</b> (3,4-Benzacenaphthenequinone)	270, red, bz					<i>mono</i> 203, or , bz	<i>mono</i> 251d , yel , ac a	subl
49	<b>1,2,5-Trihydroxy-9,10-anthraquinone</b> (Hydroxyanthrarufin)	273 4, red, ac a							2-Me eth , 229, yel , al , 1,2-Di-Me eth , 231, or , al , 1,2,5-Tri-Me eth , 203 4, yel , al , Triacetate, 228 9, yel al
50	<b>1,5-Dihydroxy-9,10-anthraquinone</b> (Anthrarufin)	280 (subl) , pa yel	379-81						Diacetate, 245d , pa yel , ac a
51	<b>Chloranilic acid</b> (2,5-Dichloro-3,6-dihydroxy-1,4-benzoquinone)	283 4, red, w (+2H <sub>2</sub> O)							Di-Me eth , 141 2, red, Di-Et eth , 107, red, Di-acetate, 182 5, yel
52	<b>9,10-Anthraquinone</b>	286	382, 376 8 (cor)					<i>mono</i> 224, pa yel , (rapid htng)	Diacetate, 260, col , ac a
53	<b>Chloranil</b> (2,3,5,6-Tetrachloro-1,4-benzoquinone)	290, yel , ac a , (slow htng , sealed tube)	subl						SO <sub>2</sub> —Tetrachlorohydroquinone, In w -alkali sol → alkali salts of chloranilic acid
54	<b>Alizarin</b> (1,2-Dihydroxy-9,10-anthraquinone)	290, or , al	430						2-Benzoate, 214 6, al , 2-p-Bromobenzoate, 195, yel , Diacetate, 184, yel , al , Di-Me eth , 215
55	<b>2-Amino-9,10-phenanthraquinone</b>	>300, dk vlt , w , sinters at 205-10							N-Acetyl, 324, dk red-vlt , PhNO <sub>2</sub> , N-Benzoyl, 297-8, br -red, PhNO <sub>2</sub>
56	<b>3-Aminoalizarin</b> (3-Amino-1,2-dihydroxy-9,10-anthraquinone)	>300, dk red, ac a							N-Acetyl, 238-40, yel -br , Monobenzoyl, 275, dk yel , Dibenzoyl, 252, yel
57	<b>1,4-Diamino-5,8-dihydroxy-9,10-anthraquinone</b> (5,8-Diaminoquinizarin)	>300, br -vlt , PhNO <sub>2</sub>							N,N'-Dibenzoyl, 284-5, br -vlt , xyl , N,N'-Diphenyl, 258-60, dk bl , bz -lgr , 1,4-Di-Me eth , 250d , vlt -blk , ac a
58	<b>Dianthraquinone</b> (9,9'-Di-anthranil-10,10'-quinone)	>300, yel							Conc H <sub>2</sub> SO <sub>4</sub> → vlt -red, CrO <sub>3</sub> → Anthraquinone, Zn dust + ac a → di-anthranol, 230 (enol), 250 (keto)

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XI. ORGANIC DERIVATIVES OF QUINONES**  
(Listed in order of increasing m.p.)\* (Continued)

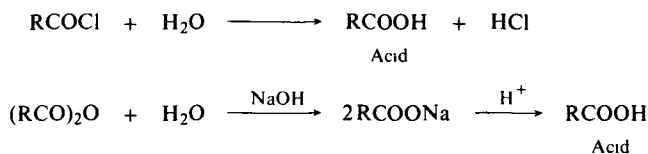
No	Name	Melting point, °C	Boiling point, °C	Semi carbazone	2,4-Dinitro-phenyl-hydrazone	p-Nitro-phenyl-hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
59	<b>2-Amino-9,10-anthraquinone</b>	306, 303 6, red, al							N-Acetyl, 262, yel, N,N-Diacetyl, 258, yel, ac a N-Benzoyl, 227 8, yel, ac a
60	<b>2-Hydroxy-9,10-anthraquinone</b>	305, yel, al	306						Acetate, 159 60, al, Benzoate, 202 4, ac a
61	<b>1,2,3-Trihydroxy-9,10-anthraquinone (Anthragallol)</b>	313 4d, br -or (290, subl)							Triacetate, 181 2, yel, al 188 9, pyr 2,3-Di-p-toluenesulfonate 196 8, yel, pyr, Tri-Me eth, 167 9, grn -yel, bz -pet, Triacetate, 181-2, yel, ac a, Tribenzoate, 213 5, pa yel, al bz
62	<b>1,2,6-Trihydroxy-9,10-anthraquinone (Flavopurpurin)</b>	>330, (>160, subl)							2,6-Di-Me eth, 239, yel, 1,2,6-Tri-Me eth, 225-6, yel Diacetate 238 Tri acetate 202 3
63	<b>1,2,7-Trihydroxy-9,10-anthraquinone (Anthrapurpurin)</b>	369, or, al							2-Acetate, 296-8 yel, al, 2,7-Diacetate, 192 3, yel, al-ac a Triacetate, 223, pa yel, ac a Tri-Me eth, 201, yel, al

\*Derivative data given in order m p, crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV

The derivatives of three classes of compounds (carboxylic acids, acyl halides and acid anhydrides) are essentially the same as those of carboxylic acids, and are prepared either directly from the acid or *via* the acyl halide. All of them appear therefore under the same title.

*Hydrolysis of acid halide or acid anhydride to the corresponding carboxylic acid*



From the acyl halide in water

*For directions and examples see* Wild, p 180

From the acyl halide with aqueous sodium hydroxide

*See* Vogel, p 369, Wild, p 180

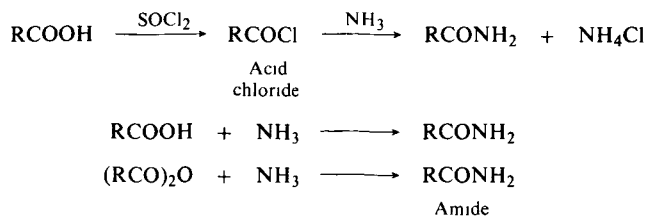
From the acid anhydride with water

*See* Vogel, p 376, Wild, p 184, A C D Rivett and N V Sidgwick, *J Chem Soc*, **97**, 1677 (1910)

From the acid anhydride with aqueous sodium hydroxide

*See* Linstead, pp 16-7 Wild, p 184

*Amide \**



Acid chloride is prepared from the acid and thionyl chloride. Amide is formed on addition of aqueous ammonia.

*For directions and examples see* Cheronis, p 440, Shriner, p 200, Vogel, p 361, Wild, p 181

From the acid chloride in benzene with aqueous ammonia

*See* D Swern, J M Stutzman and E T Roe, *J Amer Chem Soc*, **71**, 3017 (1942)

By passing gaseous ammonia through a benzene or ether solution of the acyl chloride

*See* Linstead, p 14, Wild, p 182

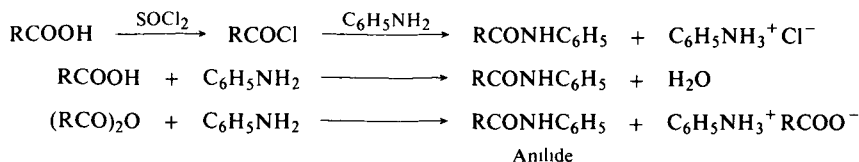
From the neat acid with gaseous ammonia

*See* J A Mitchell and E E Reid, *J Amer Chem Soc*, **53**, 1879 (1931)

From the acid anhydride with aqueous ammonia

*See* Wild, p 184, 185

*Anilide \**



From the acid chloride (prepared from the acid and thionyl chloride) and aniline in benzene or in ether

*For directions and examples see* Cheronis, p 445, Linstead, p 14, Shriner, pp 98, 200-1, Vogel, pp 361, 369, 458, Wild, p 182, P W Robertson, *J Chem Soc*, **115**, 1210 (1919)

From the acid chloride with aniline in aqueous sodium hydroxide

*See* Wild, pp 181, 219

From the acid and aniline at high temperatures

*See* Vogel, p 362

\*Derivatives recommended for first trial

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives.



EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV (Continued)

From the sodium salt of the acid with aniline and concentrated hydrochloric acid

See Shriner, p 201, Wild, p 154

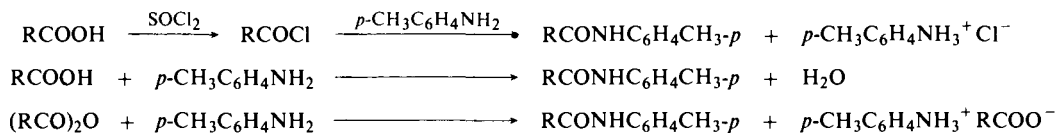
From the acid anhydride with aniline without solvent

See Linstead, p 17, Vogel, p 377, Wild, p 185

From the acid anhydride with aniline in benzene

See Linstead, p 15, Wild, p 185

*p*-Toluidide \*



From the acid chloride with *p*-toluidine in ether or benzene

For directions and examples see Cheronis, pp 441, 444, 458, Linstead, p 14, Shriner, pp 200-1, Vogel, p 361

From the acid and *p*-toluidine at high temperatures

See Cheronis, pp 441, 442-3, Vogel, p 362

From the sodium salt of the acid, *p*-toluidine and concentrated hydrochloric acid

See Shriner, p 201, Wild, p 154

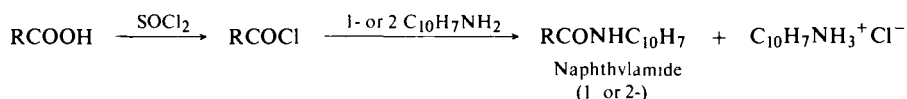
From the acid anhydride with *p*-toluidine without solvent

See Cheronis, p 459, Linstead, p 17

From the acid anhydride with *p*-toluidine in benzene

See Wild, p 185

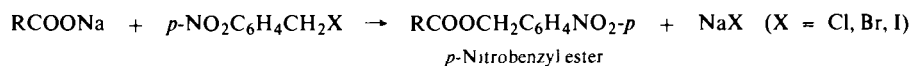
1- and 2-Naphthylamide \*



From the acid chloride with the naphthylamine

For directions and examples see Cheronis, p 446, P W Robertson, *J Chem Soc*, 115, 1210 (1919)

*p*-Nitrobenzyl ester \*



From an aqueous solution of the sodium salt of the acid, with the *p*-nitrobenzyl halide in ethanol

For directions and examples see Cheronis, pp 447, 448, Shriner, p 200, Vogel, p 362, Wild, pp 144-5

From an aqueous solution of the sodium salt of the acid with *p*-nitrobenzyl bromide in acetone

See F F Blicke and F D Smith, *J Amer Chem Soc*, 51, 1947 (1929)

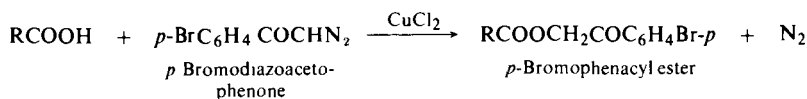
From the sodium or the potassium salt of the acid and *p*-nitrobenzyl bromide in 1:2 water-ethanol

See E E Reid, *J Amer Chem Soc*, 39, 124 (1917)

From the sodium or the potassium salt of the acid and *p*-nitrobenzyl chloride or iodide in 1:2 water-ethanol

See J A Lyman and E E Reid, *J Amer Chem Soc*, 39, 701 (1917)

*p*-Bromophenacyl ester \*



From the sodium salt of the acid and *p*-bromophenacyl bromide in aqueous ethanol

\*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives



## EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV (Continued)

From the acid chloride and ethanol.

See: Vogel, p. 389.

NOTE: The same methods can be used for the formation of other esters.

### *S-Benzylthiuronium salt.\**



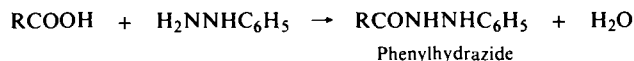
From the sodium or the potassium salt of the acid and S-benzylthiuronium chloride in water.

For directions and examples see: Linstead, p. 15; Vogel, p. 36; Wild, p. 149; S. Veibel and H. Lillelund, *Bull. Soc. Chim.* [5], 5, 1153 (1938), S. Veibel and K. Ottung, *Bull. Soc. Chim.* 6, 1434 (1939).

From the sodium or the potassium salt of the acid in water or in aqueous ethanol with an ethanolic solution of S-benzylthiuronium chloride.

See: Cheronis, p. 449; Shriner, p. 202; J. J. Donleavy, *J. Amer. Chem. Soc.*, 58, 1004 (1936).

### *Phenylhydrazide.*



From the acid with phenylhydrazine without solvent.

For directions and examples see: Shriner, p. 201; Wild, p. 152; G. H. Stempel and G. S. Schaffel, *J. Amer. Chem. Soc.*, 64, 470 (1942).

From the acid with phenylhydrazine in benzene.

See: Shriner, p. 201; Wild, p. 152.

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	<i>p</i> -Toluidide	Anilide	<i>p</i> -Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
1	Thioacetic acid	93			1.074 <sub>4</sub> <sup>10</sup>	130	76		108			
2	Formic acid	100.7	8.4	1.37137	1.22026	53	50	140-135				<i>p</i> -Nitrobenzyl ester, 31
3	Acetic acid (Ethanoic acid)	118.2	16.6	1.36976 1.3721	1.04926	153 147	114	86.0	82			<i>p</i> -Nitrobenzyl ester, 78
4	Difluoroacetic acid	134.5							52			
5	Acrylic acid	141, 140	13	1.4224	1.0621 <sub>4</sub> <sup>8</sup>	141	104.5, w		84-5, pet eth			
6	Propionic acid (Propanoic acid)	141	-20.8	1.3868	0.99336	126, 123	106	63.4	81			<i>p</i> -Nitrobenzyl ester 31
7	Propionic acid	144d	18		1.139 <sub>15</sub> <sup>5</sup>		87		61.2			
8	Isobutyric acid (Isobutanoic acid)	154.7	-46.1	1.3920	0.94791	108.5 9.5	105	76.8	128 129			
9	Methacrylic acid	161	16	1.429	1.015				102.6			<i>p</i> -Bromoanilide, 116
10	<i>n</i> -Butyric acid ( <i>n</i> -Butanoic acid)	162.5 164	-5.5 -8	1.3983 1.3979	0.95790	75	96.97	63	115.6			<i>p</i> -Nitrobenzyl ester, 35
11	Pyruvic acid ( $\alpha$ -Oxopropionic acid)	165d 80 <sup>22</sup>	13.6	1.4138	1.2668 <sub>15</sub> <sup>5</sup>	109 130	104, subl		124.5, 145			2,4-Dinitrophenylhydrazone 218, yellow
12	Vinylacetic acid (3-Butenoic acid)	169-163	-35	1.4221	1.0094		58		73			
13	Isocrotonic acid ( <i>cis</i> - $\beta$ -Crotonic acid <i>cis</i> -2-Butenoic acid)	169	15	1.4456	1.0265	132	101.2	81	101.2			
14	<i>d</i> -2-Methylbutanoic acid (Ethylmethylacetic acid)	176.7 174		1.4052	0.938 <sub>20</sub> <sup>20</sup>	92.5 3.0	110	55	112			
15	Isovaleric acid (3-Methylbutanoic acid)	176.5	-30.0	1.4043	0.92623	106.7	109.5 (cor)	68.0	135 137			
16	<i>n</i> -Amylpropionic acid (1-Heptyne-1-carboxylic acid)	180 220d	f p 2.5			68, bz			91			Nitrile, b p 194 6 <i>o</i> -Toluidide, 60, pet eth
17	3,3-Dimethylbutanoic acid ( <i>tert</i> -Butylacetic acid)	184, 96 <sup>26</sup>	6.7	1.4096	0.9124	134	132, et ac-pet eth		132	b p 126		
18	<i>d</i> -1- $\alpha$ -Chloropropionic acid	186				124	92		80			
19	Cyclopropanecarboxylic acid	186, 182.4	17, 18-9	1.43901	1.0885				125		b p 134, $n_D^{20}$ 1.41902, $D_4^{15}$ 0.96078	
20	<i>n</i> -Pentanoic acid ( <i>n</i> -Valeric acid)	186.4	-34.5	1.4086	0.93922	74	63	75	106			
21	2,2-Dimethylbutanoic acid (Dimethylethylacetic acid)	187, 190	-15.0	1.4141, 1.4145	0.9276	83.0	59.2, 90-1		103			<i>p</i> -Phenylphenacyl ester, 86
22	Ahylic acid (4-Pentenoic acid)	188.9		1.4341 1.4283	0.9843 <sub>15</sub> <sup>18</sup>				94, b p 230	b p 144.6		
23	Cyclopropylacetic acid	190 <sup>750</sup>		1.4320 <sup>25</sup>								<i>p</i> -Phenylphenacyl ester, 83
24	<i>d</i> -1-2,3-Dimethylbutanoic acid (Isopropylmethylacetic acid)	191.7	-1.5	1.4146	0.9275	112.6	78.4		132			<i>p</i> -Phenylphenacyl ester, 74
25	Dichloroacetic acid	194	5-6	1.4659	1.5634	153	118	99	98, subl			

\* Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	<i>p</i> -Toluidide	Anilide	<i>p</i> -Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
26	Cyclobutanecarboxylic acid	195	1 4403 <sup>25</sup>	1 0599					152 3	b p 136 0 - 5	b p 159 62	
27	2-Ethylbutanoic acid (Diethylacetic acid)	195	-31 8	1 4132	0 9239	116 2	127 5		112 107			
28	<i>d</i> /-2-Methylpentanoic acid (Methyl- <i>n</i> -propylacetic acid)	195 6		1 4136	0 9230	81	95		79 6			
29	<i>d</i> /-3-Methylpentanoic acid	197 5	-41 6	1 4159	0 9262	74 8	87, 88		124 9			
30	4-Methylpentanoic acid (Isocaproic acid, Isobutylacetic acid)	199 1 <sup>752</sup>	-33	1 4144	0 9225	63 0	112 0, 110 5 111 5	77 3	120 1			
31	Methoxyacetic acid (Glycolic acid methyl ether)	204, 203		1 41677	1 1768		58, pet eth		96 5 7 0, 92-4 78			
32	2-Ethyl-2-methylbutanoic acid (Diethylmethylacetic acid)	204		1 4256								
33	Hexanoic acid ( <i>n</i> -Caproic acid)	205 35	-3 9, f p -1 5- -2	1 41635	0 93568	74 5	94 5	72 0	100, 101		b p 166-7	
34	Ethoxyacetic acid (Glycolic acid ethyl ether)	206 7		1 41937	1 1021	32, eth	95 92	104 8	80-2			
35	5-Methylhexanoic acid	207 <sup>752</sup>		1 4220			75		103			
36	2-Ethylpentanoic acid (Ethyl- <i>n</i> -propylacetic acid)	209				129	94		104 5			
37	2-Methylhexanoic acid ( <i>n</i> -Butylmethylacetic acid)	209 6		1 4189 <sup>25</sup>		85	98		73 70- 2 5			
38	$\alpha$ -Chloroisovaleric acid	20-2									b p 178 9	Nitrile b p 154 5 Chloride, b p 149
39	$\alpha$ -Bromobutanoic acid	217d				92	98		112, 108			
40	4-Methylhexanoic acid	217 8 <sup>754</sup>		1 4211	0 9194		76 5		98 89			
41	2,2-Dimethylhexanoic acid	218										
42	4-Ethyl-4-methylbutanoic acid ( <i>active</i> -Amylacetic acid)	221			0 9149					b p 158 64	b p 173 9	$[\alpha]_D^{25} +7 6$ in me al
43	2-Chloro- <i>n</i> -valeric acid (2-Chloropentanoic acid)	222								b p 160	b p 185-6	Nitrile, b p 160
44	<i>n</i> -Heptanoic acid ( <i>n</i> -Heptic acid)	223 0	-7 46	1 4234	0 91808	81	70, 65	72 0	96, 96 5 102			
45	2-Ethylhexanoic acid ( $\alpha$ -Ethylcaproic acid)	228										<i>p</i> -Phenylphenacyl ester, 53 4, 49 5 50
46	Cyclohexylacetic acid	237							172			
47	<i>n</i> -Caprylic acid ( <i>n</i> -Octanoic acid)	237, 239 3	16 3	1 4268	0 90884	70	57	67 4	110, 106		b p 207 8 <sup>754</sup>	
48	Pelargonic acid ( <i>n</i> -Nonanoic acid)	254 4	12 3	1 43446 <sub>lit.</sub> , yel	0 90552	84	57	68 5	99			
49	<i>d</i> -Citronellic acid (2,6-Dimethyl-1-octene-8-carboxylic acid)	257			0 9308				84 5		b p 113	$[\alpha]_D +21$ , Nitrile, b p 230, $D^{20} 0 8645$
50	2-Phenylpropionic acid	265							92			
51	4-Acetylbutanoic acid ( $\gamma$ -Acetobutyric acid)	275d, 195- 200 <sup>65</sup>	13-4			123, w			114, chl			Semicarbazone 175d (+1 H <sub>2</sub> O), w, Oxime, 104 5 bz

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

a) Liquids 2) (Reduced pressure b.p. only) (Listed in order of increasing amide m.p.)\*

No	Name	Amide	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	<i>p</i> -Toluidide	Amide	<i>p</i> -Bromophenacyl ester	Methyl ester	Ethyl ester	Miscellaneous
1	3-Ethoxypropionic acid	51	120 <sup>17</sup>		1.4216							
2	3-Heptynoic acid	67	102 <sup>2</sup>	14	1.4635 <sup>25</sup>							
3	2-Heptynoic acid	68 9, al	135 <sup>20</sup>		1.4619	0.978				b p 91-3 <sup>19</sup> , $n_D^{20}$ 1.4455, $D_4^{20}$ 0.937		
4	<i>trans</i> -Oleic acid	75-6	216 <sup>5</sup> , 250 (superheated steam)	$\alpha$ 13.36, $\beta$ 16.25	1.4597		42.5	41	40, 46			
5	2-Fluoropropionic acid	76	60 <sup>8</sup>									
6	2-Azidoisovaleric acid (2-Triazoisovaleric acid)	78 9, bz	82 <sup>0 1</sup>			1.0638 <sup>33</sup>					b p 82 <sup>16</sup> , $D_4^{20}$ 1.0295	
7	<i>d,l</i> -Lactic acid	78 5 9 0 (cor), bz -al (3 l)	122 <sup>15</sup>	18			107	58.5-9.0, w	112.8	144.8	154	
8	<i>d,l</i> -2-Azidopropionic acid ( <i>d,l</i> -2-Triazopropionic acid)	80, bz	121.5 <sup>20</sup>								b p 70 <sup>16</sup> , $n_D^{25}$ 1.428.57, $D_4^{23}$ 1.065	Explodes on heating
9	2-Ethyl-3-Hexenoic acid	80	132 <sup>19</sup>									
10	4-Phenoxybutanoic acid	80	197 <sup>18</sup>									
11	2-Methoxypropionic acid	81	89 <sup>10</sup>									
12	1-Citronellic acid (2,6-Dimethyl-1-octen-8-carboxylic acid)	84-5	117.9 <sup>0 6</sup>		1.4563 <sup>24</sup>	0.9274 <sup>23</sup>	93-4	76		b p 86 <sup>1 1</sup>		$[\alpha]_D^{25}$ -6.6
13	2-Ethyl-4-methylpentanoic acid (Ethylisobutylacetic acid)	89	115 <sup>20</sup>									
14	2-Octynoic acid	90	133 <sup>10</sup>		1.4595			60				
15	6-Methyloctanoic acid	91	149 <sup>23</sup>		1.4337							
17	3-Methylhexanoic acid	98	112 <sup>16</sup>		1.4222							
18	2,3-Dimethylpentanoic acid	102	92 <sup>15</sup>									
19	2-Cyanopropionic acid	105, 81	142-5 <sup>11</sup>								b p 192-3	
20	7-Methyloctanoic acid	106	105 <sup>2</sup>									
21	1-Chlorocyclohexanecarboxylic acid	110, me al -w	138-40 <sup>13</sup>									Ethylamide, 53
22	2-Cyanobutanoic acid	113	153-5 <sup>15</sup>								b p 207-9	
23	Methylneopentylacetic acid	123	108 <sup>14</sup>									
24	2-Isopropylbutanoic acid (2-Ethyl-3-methylbutanoic acid)	135	105 <sup>15</sup>									
25	5-Cyclopentylpentanoic acid	136	123 <sup>4 5</sup>									
26	2-Methylcyclopentanecarboxylic acid	148	107 <sup>9</sup>		1.4504 <sup>22</sup>							
27	3,4,4-Trimethylpentanoic acid	167	98 <sup>4</sup>		1.4320 <sup>21</sup>							
28	<i>cis</i> -4-Methylcyclohexanecarboxylic acid	175	130 <sup>13</sup>									
29	Cyclopentanecarboxylic acid	179	123 <sup>27</sup>									

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point, °C	Boiling point °C	<i>p</i> -Toluidide	Anilide	<i>p</i> -Nitrobenzyl ester	<i>p</i> -Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
1	<i>β</i> -Bromobutyric acid ( <i>β</i> -Bromobutanoic acid)	20	122 <sup>16</sup>					92 3		b p 183 4	
2	<i>trans</i> - <i>β</i> -Ethyl- <i>α</i> -methylacrylic acid	24	112 <sup>12</sup> <i>cis</i> 94 <sup>10</sup>				91, <i>cis</i> 46	80			n <sub>D</sub> <sup>20</sup> 1 4578 <i>cis</i> n <sub>D</sub> <sup>25</sup> 1 4485
3	<i>d l</i> - <i>α</i> -Azidobutyric acid ( <i>d l</i> - <i>α</i> -Triazobutyric acid)	24	81 <sup>0 2</sup>					38 9, bz - pet eth		b p 64 <sup>7</sup> , D <sub>20</sub> <sup>20</sup> 1 038	
4	Undecylenic acid (10-Undecenoic acid 10-Hendecenoic acid)	24 5	275					87			Cu salt, 232-4, Pb salt, 80
5	2-Ethoxybenzoic acid (Salicylic acid ethyl ether)	24 5 5 5	300d					132			
6	<i>d l</i> - <i>α</i> -Bromopropionic acid	25 7	203 5	125	99, 100			123	b p 145- 50	b p 159- 60d	
7	<i>n</i> -Undecylic acid ( <i>n</i> -Undecanoic acid, <i>n</i> -Hendecanoic acid)	28 5, <i>α</i> 13 4, <i>β</i> 16 3	280, 284	80	71		68 2	103			
8	<i>α</i> -Chloroisobutyric acid ( <i>α</i> -Chloroisobutanoic acid)	31	118 <sup>50</sup>		69 70, al				b p 133 5	b p 148 9	
9	<i>α</i> -Azidoisobutyric acid ( <i>α</i> -Azidoisobutanoic acid <i>α</i> -Triazoisobutyric acid)	31	75 <sup>0 2</sup>					93-4		b p 71 <sup>16</sup> , D <sub>20</sub> <sup>20</sup> 1 0344	D <sub>33</sub> <sup>33</sup> 1 1433
10	Cyclohexanecarboxylic acid (Hexahydrobenzoic acid)	31, 30 1	233		146 (cor)			185 6			
11	<i>α</i> -Ketobutyric acid (2 Oxo-butanoic acid)	31	78 <sup>25</sup>					117			n <sub>D</sub> <sup>20</sup> 1 3975, <i>p</i> - Nitrophenyl- hydrazone, 194
12	Fluoroacetic acid	31-2	167-9					108			
13	Capric acid ( <i>n</i> -Decanoic acid)	31 5	268 70	78	70		67, al, 66	108, 100 1, 98, 99	b p 224	b p 243-5	n <sub>D</sub> <sup>20</sup> 1 42855
14	Bromochloroacetic acid	31 5	215 sl d					126, 117		b p 174d	Phenyl ester, 46 5, b p 266
15	2-Hexenoic acid	32	-		110						
16	<i>n</i> -Butylmethylglycolic acid	33						58			
17	<i>cis</i> -13-Docosenoic acid (Erucic acid)	33-4	264 <sup>15</sup>	75-8	55		62 5, 61 0	84			D 0 860 <sup>55</sup>
18	Levulinic acid ( <i>γ</i> -Ketovaleric acid, <i>β</i> -Acetylpropionic acid)	33-5 deliq	245-6	108 9, w	102, w	61	84	107-8d			Oxime, 96
19	Pivalic acid (Trimethylacetic acid)	35 5	163-4	119-20	132-3, 128 (cor)		75 6	155 7, 153-4, et ac -pet eth			
20	<i>d, l</i> - <i>α</i> -Methylhydrocinnamic acid ( <i>α</i> -Benzylpropionic acid)	36 5	272	130, <i>d</i> 115-6				107 8, <i>d</i> 113-4			
21	1-Cyclohexenylcarboxylic acid	38	107 <sup>2</sup>					128			
22	<i>n</i> -Hexylmethylglycolic acid	40						59			
23	5-Acetyl- <i>n</i> -valeric acid ( <i>δ</i> -Acetylpentanoic acid)	40 2, 31-2	250 3 <sup>280</sup>								Semicarbazone, 144-6, ac a
24	<i>d, l</i> - <i>α</i> -Campholytic acid (1,5,5-Trimethylcyclopenten-4-carboxylic acid)	40 5	162-5 <sup>45</sup> , 1 240- 3					103, w	b p 200		Nitrile, b p 200-5
25	<i>β</i> -Chloropropionic acid	41, w, 39, lgr	204						b p 155- 7, D <sup>0</sup> 1 198	b p 162, D <sub>20</sub> <sup>20</sup> 1 1086, n <sub>D</sub> <sup>20</sup> 1 42537	Nitrile, b p 175- 6, D <sup>18 5</sup> 1 1443
26	<i>d, l</i> - <i>α</i> -Ethylphenylacetic acid ( <i>d, l</i> - <i>α</i> -Phenylbutanoic acid)	42	270					85-7, 83			

\* Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point °C	<i>p</i> Toluidide	Anhydride	<i>p</i> Nitro benzyl ester	<i>p</i> -Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
27	<i>α</i> -Ethylpimelic acid	43	223 <sup>17</sup>		145						
28	Tridecyclic acid ( <i>n</i> -Tridecanoic acid)	43, 41 6	312, 177 <sup>10</sup>	88	80		75 0	100			
29	Lauric acid ( <i>n</i> -Dodecanoic acid)	44, 42	299	87	78		76	100, 99			
30	<i>d,l</i> - <i>α</i> -Bromoisovaleric acid	44	230d	124	116			133, bz	b p 174	b p 186	
31	Elaidic acid ( <i>trans</i> -Oleic acid)	44 5, 51	234 <sup>15</sup>				65	93-4, 89 90			<i>p</i> -Phenylphenacyl ester, 73 5, <i>p</i> -Chlorophenacyl ester, 56
32	4-Cyanobutanoic acid ( <i>γ</i> -Cyanobutyric acid)	45						69 70, sealed tube		b p 245	
33	Dimethylneopentylacetic acid	45	230 <sup>732</sup>					71			
34	<i>trans</i> -2-Methyl-2-butenic acid (Angelc acid)	45 6	185 (cor)		126, bz			127-8			Isobutyl ester, b p 177 2-Naphthylamide, 135, bz, Heating 2 hours in sealed tube → tiglic acid, 64-5
35	Dibromoacetic acid	48	232-5					156			
36	<i>α</i> -Bromoisobutyric acid ( <i>α</i> -Bromoisobutanoic acid)	48 9	198 200	92 5, al	83, al - w			148			<i>o</i> -Toluidide, 63
37	<i>tert</i> -Butylpropionic acid	48-9	110 <sup>10</sup>						b p 66 <sup>13</sup> , D <sup>0</sup> 0 9209	b p 75 <sup>15</sup> , D <sup>0</sup> 0 9209	
38	Hydrocinnamic acid ( <i>β</i> -Phenylpropionic acid)	48 7, 40	279-80 (cor)	135	98, 96	36 3	104	105, 82			<i>p</i> -Phenylphenacyl ester, 95
39	<i>β</i> -Cyanopropionic acid	48-50						97, sealed tube	b p 215, n <sub>D</sub> <sup>20</sup> 1 42427, D <sup>20</sup> 1 0792	b p 220 <sup>754</sup> , D <sup>20</sup> 1 0353	..
40	Benzylpyruvic acid	49 50 (+ $\frac{1}{2}$ H <sub>2</sub> O), w						180			Semicarbazone, 175d, Oxime, 65, Phenylhydrazone, 144-5
41	Bromoacetic acid	50	208		131	88		91	b p 144d	b p 168-9	
42	2-Pentynoic acid (Ethylpropionic acid)	50	100 <sup>10</sup>					146			
43	<i>γ</i> -Phenylbutyric acid	52	290					84			
44	<i>n</i> -Pentadecylic acid ( <i>n</i> -Pentadecanoic acid)	52 3	212 <sup>10</sup>		78	39 5-40 (cor)	77 2	102 5			
45	<i>β</i> -Campholenic acid	53 5	245					86		222 5	Nitrile, 225, D <sup>20</sup> 0 9093
46	Myristic acid (Tetradecanoic acid)	53 9	202 <sup>10</sup>	93	84		81	103			
47	Trichloroacetic acid	57 8	197 5	113	97, 94	80		141	b p 153 8	b p 168	Phenylhydrazide, 123
48	<i>α</i> -Acetoxypropionic acid (O-Acetylactic acid)	57 60, 39-40	167-70 <sup>78</sup>								Nitrile, b p 172-3
49	<i>β</i> -Acetylglutaric acid	58						<i>mono</i> 141-2, <i>al</i> -eth	89		
50	<i>sec-n</i> -Amylmalonic acid (2-Ethylbutane-1,1-dicarboxylic acid, <i>sec-n</i> -Pentylmalonic acid)	58, bz			<i>dl</i> 219-20					<i>dl</i> b p 243 5	

\*Derivative data given in order m p, crystal color, solvent from which crystallized



TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	<i>p</i> -Toluidide	Anilide	<i>p</i> Nitro-benzyl ester	<i>p</i> -Bromo-phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
51	<i>trans</i> -Brassicid acid	59.7	256 <sup>10</sup>		78		94.2	94			
52	5-Phenylpentanoic acid	60			90			109			
53	$\beta$ -Cyclohexylacrylic acid	60	154 <sup>11</sup>					159			
54	$\beta$ -Chloroisocrotonic acid	61	195 (subl)		108			110	b p 142	b p 161	
55	Margaric acid ( <i>n</i> -Heptadecanoic acid)	61.2	231 <sup>16</sup>			48.5 9.0 (cor)	82.6	108, 106			
56	Chloroacetic acid	$\alpha$ 61.3, $\beta$ 56.2 $\gamma$ 52.5	189	162	136.7		104	121	b p 130	b p 145.6	
57	$\beta$ -Bromopropionic acid	62.5						111	b p 80 <sup>27</sup> , D <sup>17</sup> 1.4897	b p 70 <sup>12</sup> , D <sup>15</sup> 1.2609	2-Naphthylamide, 174
58	Palmitic acid (Hexadecanoic acid)	62.7	222 <sup>16</sup>	98	90.6, al	42.5	86, 82	106.7, 105.3, al			
59	<i>cis</i> -2-Methyl-2-butenoic acid (Tiglic acid)	64.5-5.0	198.5 (cor)	70.0-1.5	77, pet eth	64	68	75.6, bz			
60	Cyanoacetic acid	66			198-9			119-20	b p 200	b p 207	Nitrile, 29-30, b p 218.9
61	Benzoylformic acid	66						91			Nitrile, 32-3, b p 206-8, 2,4-Dinitrophenylhydrazone, 196-7d (cor), Phenylhydrazone, 64
62	Acetoxyacetic acid	66-8, bz	145 <sup>12</sup>		89-90, w					b p 179, D <sup>17</sup> 1.0993	
63	2,3-Dibromopropionic acid	67, stab, 51, unst	160 <sup>20</sup>					130			
64	3,3-Dimethylacrylic acid	67	106 <sup>20</sup>					108			
65	2-Furylacetic acid	67			85						
66	3,3,4,4-Tetramethylpentanoic acid	67						138			
67	4-Ketocyclohexanecarboxylic acid (4-Oxocyclohexanecarboxylic acid)	67-8, bz - pet eth							b p 140 <sup>20</sup>	b p 158 <sup>40</sup>	Semicarbazone, 200d, Oxime, 147, eth
68	<i>d,l</i> -2-Phenyllactic acid	68 (+ $\frac{1}{2}$ H <sub>2</sub> O), w 94 (anh), <i>d</i> 116-7, w, <i>l</i> 115.6, bz						101.2, di- chloro- ethylene, <i>l</i> 62.5 3.5, bz			<i>d,l</i> -Et eth, 60-2, lgr, <i>d</i> - Quinine salt, 216d, al, <i>l</i> - <i>l</i> - Menthyl ester, 55.5-6.0
69	<i>d</i> -Chaulmoogric acid ( <i>d</i> - $\omega$ -Cyclopentyltridecanoic acid)	68.5	247-8 <sup>20</sup>	100	89			106, al	22	b p 230 <sup>20</sup> , D <sub>4</sub> <sup>15</sup> 0.9064	[ $\alpha$ ] <sub>D</sub> +62 in chl
70	Stearic acid (Octadecanoic acid)	70-1, 69.6		102	95.5, al		92	109, 108.4, al			
71	<i>trans</i> -Crotonic acid ( <i>trans</i> -2-Butenoic acid)	72, w	189 (cor)	132, bz	118, w, 115	67.4	95.6	159-60, bz	b p 121	b p 138, D <sub>4</sub> <sup>20</sup> 0.9175, n <sub>D</sub> <sup>20</sup> 1.42524	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	<i>p</i> -Toluidide	Anilide	<i>p</i> -Nitrobenzyl ester	<i>p</i> -Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
72	$\gamma$ -Bromocrotonic acid	74, lgr						101	b p 87 <sup>15</sup> , D <sub>4</sub> <sup>19</sup> 1 490	b p 97- 8 <sup>15</sup> , D <sub>4</sub> <sup>16</sup> 1 402,	
73	Caproylacetic acid	74d						100	n <sub>D</sub> <sup>18</sup> 1 498 b p 118 <sup>19</sup> , D <sub>4</sub> <sup>9</sup> 0 9916	n <sub>D</sub> <sup>18</sup> 1 490 b p 127 <sup>19</sup> , D <sup>9</sup> 0 9721 b p 138 <sup>18</sup>	Nitrile, b p 127- 8 <sup>14</sup> , D <sup>15</sup> 0 9914
74	3-Ketocyclohexanecarboxylic acid (3-Oxocyclohexanecarboxylic acid)	75 6, bz	195-7 <sup>20</sup>								Semicarbazone, 183-4, al, Oxime, 170d, w, Phenylhydra- zone, 125, yel
75	2-Thienylacetic acid	76						148			
76	<i>sec</i> -Butylmalonic acid (Isopentane-1,1-dicarboxylic acid)	76						<i>di</i> 242	<i>di</i> b p 217 8 <sup>748</sup>	<i>di</i> b p 245-50 <sup>762</sup>	
77	Phenylacetic acid	76 5, subl	256 5 (cor)	135-6	117-8	65	89	156			
78	Eicosanoic acid (Arachidic acid)	77, 75	204 <sup>1</sup>	96	92		89	108 9			
79	Glycolic acid (Hydroxyacetic acid)	78 9, 80		143, w	97, w	106 8	138	120, al - et ac			On prolonged heating at 100° → an h, 128 30
80	$\alpha$ -Hydroxyisobutyric acid (2-Hydroxyisobutanoic acid Dimethylglycolic acid)	79	212	132-3, w	136, w	80 5	98, acet				
81	$\alpha$ -Methylcinnamic acid	81, 74						128			
82	2-Ketocyclohexanecarboxylic acid (2-Oxocyclohexanecarboxylic acid)	81-2, eth								b p 107- 8 <sup>12</sup> , 159-60 <sup>100</sup>	Alcoholic sol + FeCl <sub>3</sub> → blue color
83	<i>n</i> -Docosanoic acid (Behenic acid)	81-2			101 2			111	54	50	
84	$\beta$ -Iodopropionic acid	82, 85						101 142			
85	$\alpha$ -Benzoylpropionic acid	82-3, bz - pet eth			137-8, al			145-6			Phenylhydrazone, 100 4, br, bz
86	Iodoacetic acid	83						95			
87	$\gamma$ -Chlorocrotonic acid	83	117 8 <sup>13</sup>					130-2, w		b p 191-3 <sup>750</sup>	Nitrile, b p 73 <sup>15</sup> , D <sup>9</sup> 1 1495 <i>p</i> -Chlorophenacyl ester, 100
88	Lignoceric acid (Tetracosanoic acid)	84					91				
89	$\beta$ -Methyladipic acid	85, 91	223 <sup>18</sup>		200						
90	$\alpha$ -Benzoylbutyric acid ( $\alpha$ -Benzoylbutanoic acid)	85-7						148-9		b p 168- 71 <sup>19</sup>	Nitrile, b p 134-5 <sup>3</sup>
91	<i>d,l</i> - $\alpha$ -Bromophenylacetic acid	86, 84						148, 144			Nitrile, 29, b p 242d
92	(4-Methoxyphenyl)acetic acid	87, 84						189			
93	Dineopentylacetic acid	88						140			
94	Dibenzylacetic acid	89		175, abs al	155, abs al			128-9, bz			
95	(2-Tolyl)acetic acid	90, 88						161			
96	$\alpha$ -Thienylglyoxylic acid	91						88			
97	$\Delta^5$ -Campholytic acid (4,5,5-Trimethylcyclopentene-1-carboxylic acid)	91						90, lgr			
98	Citraconic acid (Methylmaleic acid)	92d, 92-3, 91d, eth -lgr		<i>mono</i> 170-1, yel, eth	<i>mono</i> 153, <i>di</i> 175 5, al	<i>di</i> 70 6		<i>di</i> 185- 7d	<i>di</i> b p 210-1	<i>di</i> b p 231	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	<i>p</i> -Toluidide	Anilide	<i>p</i> -Nitrobenzyl ester	<i>p</i> -Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
99	2-Bromobenzoylformic acid	93-101						136-7, w			Nitrile, 62-4, yel, Oxime, 162-4d
100	$\beta$ -Chlorocrotonic acid	94	206-11 sl d		123-4			100 1	b p 64 7 <sup>14</sup> , D <sub>4</sub> <sup>22</sup> 1 555, n <sub>D</sub> <sup>20</sup> 1 463	b p 180, 184, D <sub>4</sub> <sup>20</sup> 1 1062, n <sub>D</sub> <sup>20</sup> 1 459	1-Naphthylamide, 169-70
101	Phenyl- <i>n</i> -propylglycolic acid	94						132			
102	(2-Chlorophenyl)acetic acid	95, w		170	138 5			175, w			Nitrile, 25, b p 251, <i>o</i> -Toluidide, 174
103	(4-Tolyl)acetic acid	95, 91	159 <sup>15</sup>					185			
104	<i>o</i> -Chlorohydrocinnamic acid	96 5, w						119, bz	b p 255		Nitrile, b p 267-8
105	2-Hydroxy-3-phenylpropionic acid	97, 96						112			
106	1,2,3,4-Tetrahydro-2-naphthoic acid	97						139			
107	Glutaric acid (1,3-Propanedicarboxylic acid)	98	302 4	<i>di</i> 218	<i>di</i> 223 4	<i>di</i> 69	<i>di</i> 136 8	<i>di</i> 175-6			
108	3-Phenoxypropionic acid	98						119			
109	$\alpha$ -Crotonic acid	99	212					112	161	176	Nitrile, b p 136
110	Phenoxyacetic acid	98-9, 99 100	285d		99, al		148 5	101 5			
111	2-Benzofurylacetic acid	99						164			
112	1-Naphthylglycolic acid	99 124-5						135			
113	Citric acid	100 (+1 H <sub>2</sub> O), 153 (anh)		<i>tri</i> 189, al	<i>tri</i> 192	<i>tri</i> 102	<i>tri</i> 148	<i>tri</i> 210- 5d, w			
114	2-Methoxybenzoic acid ( <i>o</i> -Anisic acid Salicylic acid methyl ether)	100 1	200				113	129			
115	<i>l</i> -Malic acid (Hydroxysuccinic acid)	100-1		<i>di</i> 206-7	<i>di</i> 197	<i>mono</i> 87 2, <i>di</i> 124 5	<i>di</i> 179	<i>di</i> 156-7, <i>d,l</i> 162 3			
116	Oxalic acid	101 (+2 H <sub>2</sub> O) (rapid htng), 189 5 (anh) subl at 150-60		<i>mono</i> 169, <i>di</i> 268	<i>mono</i> 148 9, <i>di</i> 254, 246, bz	<i>di</i> 204		<i>mono</i> 219, <i>di</i> 419d			
117	Acetylpyruvic acid (2,4-Diketone-valeric acid, 2,4-Dioxopentanoic acid)	101, bz						131-2d, al	63-4		
118	<i>n</i> -Butylmalonic acid (Pentane-1,1-dicarboxylic acid)	101			<i>di</i> 193			<i>di</i> 200		<i>di</i> b p 235-40	Mononitrile, 122 5-6 5, w, subl
119	$\alpha$ -Cyanohydrocinnamic acid (Benzylcyanoacetic acid)	101-2						130		b p 176-85 <sup>21</sup>	
120	2-Chloro-6-methylbenzoic acid	102, w						167			Nitrile, 82-3, pet eth
121	Aleuritic acid (9,10,16-Trihydroypalmitic acid)	102, w							63-4		Hydrazide, 139-40, Azide, 50d, al

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	<i>p</i> -Toluidide	Anilide	<i>p</i> -Nitrobenzyl ester	<i>p</i> -Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
122	(2-Bromophenyl)acetic acid	103.4, 109						186.7			Nitrile, b p 145.7 <sup>14</sup>
123	Benzylacetic acid	103.4d			107.8			113			Nitrile, 80.1, 1-Menthyl ester, 41
124	Pimelic acid	104-5, subl	223 <sup>15</sup>	<i>di</i> 206, al	<i>mono</i> 108.9 <i>di</i> 155.6, me al-w		<i>di</i> 136.6	<i>di</i> 175			
125	2-Toluic acid (2-Methylbenzoic acid)	104.5, 107.8	259 <sup>751</sup>	144	125	90.7	57	142.8 (cor)			
126	Allylmalonic acid	105, eth				46, al				<i>di</i> b p 222-3	Mononitrile, b p 223. Dinitrile, b p 217.8
127	(4-Chlorophenyl)acetic acid	105-6, 104		190	164.5, al			175, al		32, b p 260	<i>o</i> -Toluidide, 190, bz Nitrile, 30, b p 265-7
128	$\Delta^2$ -Cyclogeranic acid (1,5,5-Tri-methylcyclohexene-6-carboxylic acid)	106, lgr	138 <sup>11</sup>					120.1, bz-pet eth		b p 101.2 <sup>10</sup>	
129	<i>d</i> -Campholic acid ( <i>d</i> -1,2,2,3-Tetramethylcyclopentane-1-carboxylic acid)	106, <i>d</i> / 109	255		91			80, <i>d</i> / 90	b p 208	b p 220	Nitrile, 73, Anhydride, 56, <i>d</i> / 66
130	Atropic acid (1-Phenylacrylic acid)	106-7, w			134			121.2, w		b p 124 <sup>16</sup> , $n_D^{20}$ 1.52605	
131	<i>l</i> -Campholic acid	106-7	250					78-9	b p 211	b p 228	Anhydride, 57.8
132	Azelaic acid (Heptane-1,7-dicarboxylic acid)	106.5	>360 sl d, 237 <sup>15</sup>	<i>di</i> 201.2	<i>mono</i> 107-8, dil al, <i>di</i> 186.7	<i>di</i> 43.8	<i>di</i> 130.6	<i>mono</i> 93-5, <i>di</i> 175			
133	Methylnepentylglycolic acid	109						116			
134	<i>trans</i> -4-Methylcyclohexane-carboxylic acid	111						226			
135	<i>cis</i> - $\alpha$ -Chloroallocinnamic acid	111			138.9, al-w			134, bz	b p 153.4 <sup>28</sup>	b p 157.8 <sup>10</sup> , D <sub>4</sub> <sup>25</sup> 1.569, $n_D^{25}$ 1.5525	
136	Ethylmalonic acid	111			150	75		<i>di</i> 214			
137	3-Toluic acid (3-Methylbenzoic acid)	111.3, 110-1	263, subl	118	126	86.6	108	94, 97			
138	<i>O</i> -Benzoyllactic acid (Lactic acid benzoate)	112						124		b p 288	Nitrile, b p 269-70, 1-Naphthylamide, 155, 2-Naphthylamide, 177
139	2,4,6-Triethylbenzoic acid	113						156			
140	2-Phenylbenzoic acid	113						177			
141	(1-Naphthyl)glyoxylic acid	113						151			
142	Bromomalonic acid	113d		<i>di</i> 217, ac a				<i>di</i> 181, al	<i>di</i> b p 215-25	<i>di</i> b p 233-5d 30	Dinitrile, 65-6
143	(4-Bromophenyl)acetic acid	114, subl						192.4			Nitrile, 46.7
144	2-Acetylbenzoic acid (Acetophenone- <i>o</i> -carboxylic acid)	114-5						116.5, w			Oxime, 159, 2,4-Dinitrophenylhydrazone, 186

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	<i>p</i> -Toluidide	Anilide	<i>p</i> -Nitrobenzyl ester	<i>p</i> -Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
145	Pyrotartaric acid (Methylsuccinic acid)	115		164	<i>mono</i> 159, et ac 123, chl <i>di</i> 200			<i>di</i> 225			
146	2-Phenoxypropionic acid	115-6, 112-3		115	117 118 9			132 3, 130			
147	3-Benzoylpropionic acid	116			150, 145			145-6, w		18 9	Semicarbazone, 181d Dinitrile, 91, 79
148	Benzylmalonic acid	117d, 121			<i>di</i> 217	<i>di</i> 119 5		<i>di</i> 225			
149	<i>d l</i> -Tropic acid (3 Hydroxy-2 phenylpropionic acid)	117 8 <i>d</i> 130						169			
150	Cuminic acid (4 Isopropyl benzoic acid)	117-8, al						133		b p 263 4	Nitrile, b p 243-4 <sup>73a</sup>
151	<i>d l</i> -Mandelic acid ( $\alpha$ -Hydroxyphenylacetic acid)	118, <i>d</i> 133 <i>l</i> 134		172, al	151 2, al	123 4		133 4 (cor)			
152	<i>l</i> -Arabonic acid	118 9, al		200	204			136, me al			<i>o</i> -Toluidide, 172
153	$\alpha$ -Chlorodiphenylacetic acid	118-9d, bz -lgr			88			115		43 4	Anhydride, 219
154	<i>d l</i> -Citramalic acid ( <i>d l</i> -2-Hydroxy-2-methylsuccinic acid)	119						<i>mono</i> 140 1	<i>di</i> b p 112 <sup>15</sup>		Me eth, 90 2 Et eth, 81 3
155	Anilinomalonic acid	119d, al - lgr			<i>mono</i> 157d, w <i>di</i> 162, 246 7, ac a			<i>di</i> 156	<i>di</i> 68	<i>di</i> 45, al	
156	4-Chloromandelic acid	119 22, 112 3						122 3			Nitrile, 43 Me eth 85-8, bz pet eth
157	(3-Nitrophenyl)acetic acid	120						110			
158	<i>cis</i> -2-Bromoalocinnamic acid	120						129	b p 111 <sup>16</sup> , D <sub>4</sub> <sup>20</sup> 1 4726	b p 173 4 <sup>30</sup> , D <sub>4</sub> <sup>25</sup> 1 3713	
159	3-Furoic acid (3 Furancarboxylic acid)	121						169			
160	1-Cyclopentenylcarboxylic acid	121		122	126						
161	Cetylmalonic acid (Heptadecane-1,1-dicarboxylic acid)	121 5 2 0, ac a						<i>mono</i> 130 50d, lgr -al 226	<i>di</i> 44, eth	<i>di</i> 22	
162	<i>cis</i> -1,3-Cyclopentanedicarboxylic acid	122 <i>trans</i> 161									
163	<i>d l</i> - <i>trans</i> -Camphenic acid ( <i>d l</i> - <i>trans</i> -Camphenecamphoric acid)	122 3, ac a			<i>di</i> 165, ac a			<i>di</i> 231 2, ac a			
164	Benzoic acid	122.4, at 100, subl	249	158	160, boil 50% al 164	89	119 0	130	b p 199 6	b p 212 6	
165	3,3,3-Trichlorolactic acid	124						96			
166	3-Nitrosahelic acid	125 (hyd)						145			
167	Diethylmalonic acid	125				<i>di</i> 91		<i>mono</i> 146, <i>di</i> 224			
168	1,14-Tetradecanedicarboxylic acid	126			163						

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	<i>p</i> -Toluidide	Anilide	<i>p</i> -Nitrobenzyl ester	<i>p</i> -Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
169	<b>2,4-Dimethylbenzoic acid</b>	127 (anh ) 90 (hyd )			141			179-81			
170	<i>cis</i> -2-Chloroallicinnamic acid	127						112			
171	<b>2-Benzoylbenzoic acid</b> (Benzophenone-2-carboxylic acid)	128, 91 (+1 H <sub>2</sub> O), w			195	100 4		165 (cor )	52		
172	<b>1,10-Decanedicarboxylic acid</b>	128						185			
173	<b>2-Thenoic acid</b> (2-Thiophene-carboxylic acid)	129						180			
174	<b>4-Bromopyromucic acid</b> (4-Bromofuran-2-carboxylic acid)	129						155-6		29 b p 235 6	
175	<b>Maleic acid</b> ( <i>cis</i> -Butenedioic acid)	130 (+30% Fumaric a ), 137 (pure)		<i>di</i> 142, eth	<i>mono</i> 198, 187, yel, al, <i>di</i> 187, al	<i>di</i> 91 (cor )	168 70, 190	<i>mono</i> 172 3, w 153 sl d, <i>di</i> 260, 181, me al			Heated at 160 → anh, 60, b p 202
176	<b>Tribromoacetic acid</b>	131, 135	245d					122			
177	(1-Naphthyl)acetic acid (1-Naphthaleneacetic acid)	131, 135			155, al, 159 6			180 1, al			
178	<i>trans</i> - $\alpha$ -Bromocinnamic acid	131-2						119	23	b p 294-6	
179	<b>2,5-Dimethylbenzoic acid</b>	132			140			186			
180	<i>cis</i> - $\beta$ -Chloroallicinnamic acid	132		142	134 5			76	34	b p 265 sl d	
181	<i>trans</i> -Cinnamic acid	133	300	168	153, 109	116 8	145 6	147 8			Nitrile, 20-1, b p 255 6
182	<b>Chloromalonic acid</b>	133			<i>di</i> 118, w			<i>di</i> 170	<i>di</i> b p 206-8 <sup>772</sup>	<i>di</i> b p 222	Di- <i>p</i> -bromo-anilide 239
183	<b>Sebacic acid</b> (Decanedioic acid, Octane-1,8-dicarboxylic acid)	33, subl	243 <sup>15</sup>	<i>di</i> 201	<i>mono</i> 122 3, <i>di</i> 201 2	<i>di</i> 73 5, 72 6	<i>di</i> 147	<i>mono</i> 170, <i>di</i> 210, 208			Phenylhydrazide, 194
184	<b>2-Furoic acid</b> (2-Furancarboxylic acid, Pyromucic acid)	133-4, 132	230-2	170 5, al	123 5, al	133 5	138 5	142 3		34, b p 195	
185	<b>Malonic acid</b> (Propanedioic acid)	134 8- 9		<i>mono</i> 156d, <i>di</i> 252-3, al	<i>mono</i> 132, <i>di</i> 230, 227-8, al	<i>di</i> 85 5		<i>mono</i> 106 10, <i>di</i> 170, w-al		<i>di</i> b p 199	Phenylhydrazide, 194
186	<b>O-Acetylsalicylic acid</b> (Aspirin)	135, rapid htng	140d		136	90 5		138			Phenacyl ester, 105
187	<b><math>\beta</math>-Campholytic acid</b> (1,5,5-Tri-methylcyclopentene-2-carboxylic acid)	135	247-9, 255-6	114	104, al - w			130	b p 203 4	b p 214	
188	<b>2-Anilinoisovaleric acid</b>	135, w						102 3		b p 275- 80	
189	<b>Acetone-1,3-dicarboxylic acid</b>	135d, et ac			<i>di</i> 155, al						Oxime, 53 4 w Acids or alkalis → acetone b p 56 + CO <sub>2</sub>
190	<i>d l cis</i> -Camphenic acid ( <i>d l cis</i> -Camphenecamphoric acid)	135-7			<i>di</i> 212			<i>di</i> 225			
191	<b>Phenylpropionic acid</b>	136-7, subl		142	128, 126, 125	83		99-100, 109			Melts under w at 80

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	p-Toluidide	Anilide	p-Nitrobenzyl ester	p-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
192	<i>trans</i> -Glutaconic acid	136-8			<i>mono</i> 167, <i>di</i> 228						Acetic anhydride → anh 88
193	3-Ethoxybenzoic acid	137						139 0- 5			
194	Methylmalonic acid	137, 138d		<i>mono</i> 145d, <i>di</i> 228, 214				217, 206			
195	<i>trans</i> - $\alpha$ -Chlorocinnamic acid	137-8		116, al	118, al			121 2	33	<i>b p</i> 209 <sup>75</sup> , D <sub>4</sub> <sup>25</sup> 1 1719, n <sub>D</sub> <sup>25</sup> 1 5705	
196	3-Thenoic acid (3-Thiophenecarboxylic acid)	138					130	180			
197	<i>cis</i> -Cyclobutane-1,2-dicarboxylic acid	138						<i>di</i> 228, w	<i>di b p</i> 225	<i>di b p</i> 238-42 <sup>720</sup>	Anhydride, 75 71-3
198	2-Pyridinecarboxylic acid (Picolinic acid)	138						107			
199	(3-Chloromethyl)benzoic acid	138, w						124		<i>b p</i> 168 9 <sup>25</sup>	Nitrile 67 al <i>b p</i> 258 60
200	5-Chloro-2-nitrobenzoic acid	139, w			164, eth			154, eth	48 5, me al		Methylamide, 134, al -w, Dimethylamide, 104 5
201	Anhydrocamphoronic acid	139			202 3				$\alpha$ 138, $\beta$ 45		
202	Butane-1,1,4-tricarboxylic acid	139 40, bz -et ac			<i>mono</i> 177					<i>tri b p</i> 175 6 <sup>18</sup> , D <sup>15</sup> 1 0726	
203	<i>meso</i> -Tartaric acid	140			<i>mono</i> 193-4, pa yel, w	93		<i>di</i> 187, 189 90, dil me al			Diphenylhydrazide 245
204	3-Nitrobenzoic acid	140		162	154	141	132	143	78 5, 70	47, 40-1	
205	3-Bromo-4-toluic acid (2-Bromo-4-methylbenzoic acid)	140						137, subl			Nitrile, 47
206	2-Chloro-4-nitrobenzoic acid	140-2			168			172, al	73-5		
207	(2-Nitrophenyl)acetic acid	141, 138						161			
208	Furanacrylic acid ( $\beta$ -(2-Furyl)acrylic acid)	141	286					168 9			
209	2-Anilinobutyric acid	141			92, al			123, w		26, b p 278	Nitrile, 39
210	(2-Naphthyl)acetic acid (2-Naphthaleneacetic acid)	141-2, 143						200, 205			
211	4-Chloro-2-nitrobenzoic acid	142, w						172, al	41 3		Nitrile, 98
212	<i>trans</i> - $\beta$ -Chlorocinnamic acid	142		122-5	128			118	29	<i>b p</i> 293	
213	2-Chlorobenzoic acid	142, 140		131	114, 118, pet eth	106	106	142, 202	<i>b p</i> 234	<i>b p</i> 243	
214	(2-Bromophenoxy)acetic acid	142 5, al						151, al		<i>b p</i> 160 70 <sup>16</sup>	

\* Derivative data given in order m p, crystal color, solvent from which crystallized

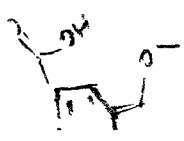


TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point °C	<i>p</i> -Toluidide	Anilide	<i>p</i> -Nitrobenzyl ester	<i>p</i> -Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
215	Suberic acid (Octanedioic acid, Hexane-1,6-dicarboxylic acid)	144, 139 41		<i>di</i> 218, 219	<i>mono</i> 128 9, <i>di</i> 186-7 154 5	<i>di</i> 85	<i>di</i> 144 2	<i>mono</i> 125 7, <i>di</i> 216-7		<i>di</i> b p 282 6	
216	Asaronic acid (2,4,5-Tri-methoxybenzoic acid)	144, bz - pet eth	ca 300					184 5	97 5, yel	72, yel	Nitrile, 112-4, al
217	(2-Chlorophenoxy)acetic acid	145 6, w			121			149 5	b p 186 8	32	
218	2-Nitrobenzoic acid	146			155	112	107	176	b p 275, 269, D <sub>4</sub> <sup>10</sup> 1 286	30, b p 148 50 <sup>10</sup>	
219	Phthalonic acid	146			<i>mono</i> 176 <i>di</i> 208			$\alpha$ 179d $\beta$ 155d			Phenylhydrazone, 171 2
220	(2-Hydroxyphenyl)acetic acid	147 149, 141						118			
221	2-Anilinovaleric acid (2-Anilinopentanoic acid)	147-8, al -w						99, etb - pet eth			Nitrile, 51, pet eth
222	Diphenylacetic acid	148		172 3	180			167 5 8 0			
223	Diglycolic acid	148, 142		<i>mono</i> 148, w	<i>mono</i> 118, <i>di</i> 152, eth al (2 1) <i>di</i> 154			<i>mono</i> 135			
224	Oxanilic acid	148 9						228			
225	(4-Hydroxyphenyl)acetic acid	148 50, 148, w						175			Benzoate of amide, 167 9
226	2-Bromobenzoic acid	150			141	110	102	155	b p 243 4	b p 254-5	
227	Benzilic acid ( $\alpha$ -Hydroxy-diphenylacetic acid)	150		189-90	174 5	99 5	152	153, chl, 154 5	74-5	34	Acetate, 98, ac a
228	Citric acid (2-Hydroxypropane-1,2,3-tricarboxylic acid)	153 (slow htng)		<i>tri</i> 189 al	<i>tri</i> 192, al -w 198	<i>tri</i> 102	<i>tri</i> 148	210 5d			Triphenyl ester, 124
229	(4-Nitrophenyl)acetic acid	153					207	198			
230	2,5-Dichlorobenzoic acid	153						155			
231	Phenylmalonic acid	153						233			
232	Adipic acid (Butane 1,4-dicarboxylic acid)	153 4 (cor)	216 <sup>15</sup>	241	<i>mono</i> 151 3 w <i>di</i> 240 1 al	106	154 5, 152 6	<i>mono</i> 125 30, w, <i>di</i> 220	3, b p 162 <sup>10</sup>	<i>di</i> 8, b p 112 <sup>10</sup> , f p 0	Diphenyl ester, 105-6, al -w
233	(4-Bromophenoxy)acetic acid	153-4 al								54, al	Phenyl ester, 73, al Oxime, 159
234	Phenylpyruvic acid	154									
235	3-Bromobenzoic acid	155			136	105	120	155	31 2	b p 254-5	
236	2,4,6-Trimethylbenzoic acid	155, 153						188			
237	2-Chloro-4-methylbenzoic acid	155-6						182			Nitrile, 61-2, subl
238	(4-Chlorophenoxy)acetic acid	155 6, w, 158			125		136	133	b p 177 80	49	
239	3-(1-Naphthyl)propionic acid	156						104			
240	Tartronic acid (Hydroxymalonic acid)	156 8d						<i>di</i> 198, dil al, 195-6d			
241	Benzoilpyruvic acid	156 8d (+1 H <sub>2</sub> O), al -w						138d	59, 62	46	1-Oxime, 98- 100d (+1 H <sub>2</sub> O)

\*Derivative data given in order m p, crystal color, solvent from which crystallized



**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	<i>p</i> -Toluidide	Anilide	<i>p</i> -Nitro benzyl ester	<i>p</i> -Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
242	<b>Cyclobutane-1,1-dicarboxylic acid</b>	157, w 158			<i>di</i> 214 5			<i>di</i> 275 7		b p 218 <sup>12</sup> <i>di</i> b p 222 6	Dihydrazide 109 10 al -w
243	<b>3-Chlorobenzoic acid</b>	158 155			122 5 al	107	116	134	21 b p 231	b p 245	
244	<b>Salicylic acid</b> (2 Hydroxybenzoic acid)	158 3, subl at 76		156	136	97 8	140	142 139	-8 6 b p 223 3	1 3 b p 234 231 5	
245	<b>1-Naphthoic acid</b>	161 2 (cor)			162 3 164		135 5	202 205			
246	<b>2-Iodobenzoic acid</b>	162			141	111	143	110	184		
247	<b>2-Anilino propionic acid</b>	162, w			127, al			144		b p 272	Nitrile, 92, al N-Acetyl, 143, w
248	<b>4-Dibenzothiopylacetic acid</b>	162						206			
249	<b>Alloxanic acid</b>	162 3d, eth						191, w	171, et ac	115, acet - chl	Phenylamide 99, eth
250	<b>5-Chloro-3-nitrosalicylic acid</b> (5-Chloro-2-hydroxy-3-nitrobenzoic acid)	163						199		91, al	
251	<b>2-Benzofurylacetic acid</b>	163						210			
252	<b>Cholanic acid</b>	164, ac a						175		93-4, 80% al	[ $\alpha$ ] <sub>D</sub> <sup>20</sup> +21 74 in chl, Propyl ester 56-7, Butyl ester, 53
253	<b>4-Nitrophthalic acid</b>	165		<i>mono</i> 172	192			200d			
254	<b>Itaconic acid</b> (Methylene-succinic acid)	165			<i>mono</i> 151 5, eth	<i>di</i> 90 6	<i>di</i> 117 4	<i>di</i> 191 2 8, al			
255	<b>5-Bromosalicylic acid</b> (5-Bromo-2-hydroxybenzoic acid)	165			222			232	61, b p 264 6	50	
256	<b>6-Chloro-3-nitrobenzoic acid</b>	165, w						178, w 130	73, me al	28 9	Nitrile, 105-6
257	<b>3,4-Dimethylbenzoic acid</b>	166, 164			104, 108			130			
258	<b>Tricarballic acid</b> (Propane-1,2,3-tricarboxylic acid)	166			<i>tri</i> 252, PhNO <sub>2</sub>		<i>tri</i> 138 2	<i>tri</i> 205 7d 133			
259	<b>Mesitylenic acid</b> (3,5-Dimethylbenzoic acid)	166						133			
260	<b><i>d,l</i>-Phenylsuccinic acid</b>	167-8, 84 (anh), <i>d,l</i> 173 4		<i>mono</i> ( $\alpha$ ) 175, <i>mono</i> ( $\beta$ ) 168-9	<i>mono</i> ( $\alpha$ ) 175, <i>mono</i> ( $\beta$ ) 171, <i>di</i> 222			<i>mono</i> ( $\alpha$ ) 158 9 <i>mono</i> ( $\beta$ ) 145, <i>di</i> 211			
261	<b>Mesitylacetic acid</b>	168						210			
262	<b>3-Chloro-4-hydroxybenzoic acid</b>	169 70, w, 164-5						180 2	106 7	77 8	Nitrile, 155
263	<b><i>d</i>-Tartaric acid</b>	169 71			<i>mono</i> 180d, 194 (cor), ac a, <i>di</i> 263 4d, al	<i>di</i> 163	<i>di</i> 204	<i>mono</i> 171-2, <i>di</i> 196d, al			Phenylhydrazide, 240

\* Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	<i>p</i> -Toluidide	Anilide	<i>p</i> -Nitrobenzyl ester	<i>p</i> -Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
264	Azobenzene-3-carboxylic acid	170 1, or, al						198-9, or, al	58, me al		
265	2,2-Diphenylpropionic acid	171 175						149			
266	8-Chloro-1-naphthoic acid	171 2, al-w						207 5, red, al		50	
267	4-Bromo-2,5-dimethylbenzoic acid	171 5 2 5, lgr						209-10			Nitrile, 103-4
268	5-Chlorosalicylic acid (5-Chloro-2-hydroxybenzoic acid)	172 w						226-7	50, b p 249d	25	Nitrile, 165-7, Phenyl ester, 81-3, Me eth, 81-2, Et ester, 118
269	4-Chloro-2-methylbenzoic acid	172						183		b p 258	Nitrile, 67
270	2,4-Dibromobenzoic acid	174						198			
271	3-Aldehydebenzoic acid (3-Formylbenzoic acid)	175						190d	53	b p 278	Nitrile, 79-81, eth, Semicarbazone, 265, Phenylhydrazone, 164
272	3-Thianaphthenecarboxylic acid	175			173			198			
273	Apiolic acid (2,5-Dimethoxy 3,4-methylenedioxybenzoic acid)	175, w							71-2, w		Nitrile, 135 5, al-w
274	Allomucic acid (2,3 4,5-Tetrahydroxyadipic acid)	176d, w						175 6, w, di 209d, w		di 139-41 al	Polyphenylhydrazide, 218d, al
275	8-Bromo-1-naphthoic acid	178, bz			151, al			179-80	33, pet eth	52, pet eth	
276	3-Phenanthrylacetic acid	178						176			
277	Acetylenedicarboxylic acid	179						di 294d			
278	4-Toluic acid (4-Methylbenzoic acid)	179 80, subl 182	275 (cor)	160, 165	144 5, 148, 140	104 5	153	160, 158			
279	6-Bromo-3-nitrobenzoic acid	180			166, al			197-8	82	66	Nitrile, 117, subl
280	5-Bromo-2,4-dimethylbenzoic acid	180 1						197 5-8 5			Nitrile, 88-9
281	Veratric acid (3 4 Di methoxybenzoic acid)	181 (anh)			154			164			
282	<i>N</i> -Benzoylanthranilic acid (2-Benzamidobenzoic acid)	181			279			218-9	100	98	Nitrile, 156
283	4-Chloro-3-nitrobenzoic acid	181-2			131			156, al	83, me al	59, yel	Nitrile, 100-1
284	3,5-Dinitrosalicylic acid (3,5-Dinitro-2-hydroxybenzoic acid)	182 (anh) 174 (+1H <sub>2</sub> O)						181			
285	4-Fluorobenzoic acid	182 182 6						154, 154 5			Nitrile, 35
286	4-Chloropicolinic acid (4-Chloropyridine-2-carboxylic acid)	182d						158, 152-4	57-8		Phenyl ester, 68, pet eth
287	2,4-Dinitrobenzoic acid	183				142	158	203			
288	2-Naphthoic acid	184, 185 5		192, al	171, bz, 173			192-3, al, 195			
289	3-Bromosalicylic acid (3-Bromo-2-hydroxybenzoic acid)	184						165			Nitrile, 49-50
290	2-Anilinoisobutyric acid (2-Anilinoisobutanoic acid)	184 5, w			155, al			136			Nitrile, 93-4, al
291	4-Anisic acid (4-Methoxybenzoic acid)	184 6, 184 2 (cor)	275-80	186	169-71	132	152	167, 162-3, w			

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point, °C	<i>p</i> -Toluidide	Anilide	<i>p</i> -Nitro benzyl ester	<i>p</i> -Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
292	(2-Carboxyphenyl)acetic acid (Homophthalic acid)	185, 180						228			
293	Acetylanthranilic acid	185, ac a			167 8, al			177, al			Nitrile, 133, w, <i>N</i> -Methylamide, 172 al
294	Succinic acid (Butanedioic acid, Ethane-1,2-dicarboxylic acid)	185, 182 8	235d	<i>mono</i> 179 80, <i>di</i> 254 5-5 5, 260	<i>mono</i> 148 5, <i>di</i> 230, al	<i>di</i> 88	<i>di</i> 211 0	<i>mono</i> 157 <i>di</i> 260d, w			
295	5-Bromopyromucic acid (5-Bromofuran-2-carboxylic acid)	186, w						144 5		b p 234	Hydrazide 135 5 6 0, Azide, 66 7
296	Hippuric acid	187			208	136	151	183			
297	3-Iodobenzoic acid	187				121	128	186			
298	5-Bromo-2-toluic acid (4-Bromo-2-methylbenzoic acid)	187, subl						180			Nitrile, 70
299	2-Cyanobenzoic acid (Phthalic acid mononitrile)	187, 192						173	151	70	
300	3-Nitroanisic acid (4-Methoxy-3-nitrobenzoic acid)	187			163						
301	Fluorene-2-acetic acid	187						266			
302	Coumarin-3-carboxylic acid	187d, w			250			236	116-7	94	Nitrile, 182
303	<i>d</i> -Camphoric acid (1,2,2-Trimethylcyclopentane-1,3-dicarboxylic acid)	187 5-8 0, <i>l</i> 187, <i>d,l</i> 202, 208		( $\alpha$ ) 212-4, ( $\beta$ ) 190-6	<i>mono</i> ( $\alpha$ ) 204, 209 10, <i>mono</i> ( $\beta$ ) 196, <i>di</i> 226, <i>l</i> 226	65 5		<i>mono</i> ( $\alpha$ -amide- $\beta$ -acid) <i>di</i> b p 176, <i>mono</i> ( $\beta$ -amide- $\alpha$ -acid) 182-3, <i>di</i> 192-3	( $\alpha$ ) 77 ( $\beta$ ) 86 <i>di</i> b p 263 4	( $\alpha$ ) 47 8 ( $\beta$ ) 57 <i>di</i> b p 285 6	
304	3-Bromophthalic acid	188								<i>mono</i> 127 8	Anhydride, 132-4
305	4-Bromo-3,5-dinitrobenzoic acid	188, al						188, pa yel, al -w	125 me al -w	118, al -w	
306	Butane-1,2,3,4-tetracarboxylic acid (low melting form)	189, w			187 (rapid htng), al -w			<i>di</i> 181d, dil H <sub>2</sub> SO <sub>4</sub> <i>tetra</i> 310d, w 211-2, w 169 70	<i>tetra</i> 75-6, w	<i>di</i> 168 w	Heating $\rightarrow$ monoanh of high melting form
307	Anthroxanic acid	190, 196d							70	64-5	
308	$\alpha$ -Chrysenic acid ( <i>o</i> -2-Naphthylbenzoic acid)	190							63		
309	<i>l</i> -Ascorbic acid	190d, <i>d,l</i> 168-9									[ $\alpha$ ] <sub>D</sub> <sup>25</sup> +48 in me al, Diphenylhydrazone, 178d, red, Di- <i>p</i> -nitrophenyl hydrazone 262d al Di 2 4 dinitro phenylhydrazone, 282d, br-red

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	<i>p</i> -Toluidide	Amide	<i>p</i> -Nitro benzyl ester	<i>p</i> -Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
310	Chlorofumaric acid	191 2, ac a			186, al	<i>di</i> 138 5			<i>di</i> b p 224	<i>di</i> b p 250 sl d	Ethyl ester amide, 102
311	<i>N</i> -Methylacetylthranilic acid	192 3					155				<i>N</i> -Methylamide, 171 2 <i>N</i> -Ethylamide, 140
312	Coumarilic acid (Coumarone-2-carboxylic acid)	192 3, w	310 5 sl d		159			159		27	Nitrile, 36, Phenyl ester, 101
313	Dimethylmalonic acid	193, subl				83 6		<i>di</i> 269			
314	<i>trans</i> -Aconitic acid	194 5d (cor ), <i>cis</i> 125 → <i>trans</i> on heating			<i>di</i> 189, <i>cis</i> , <i>mono</i> 170d, al		<i>tri</i> 186	<i>tri</i> 250 → br, 260 → sinters			Heat → Itaconic acid, 165
315	Benzylidenemalonic acid	195 6d						<i>di</i> 189 90	<i>di</i> 44	85, <i>di</i> 32	Mononitrile, 183 Dinitrile, 87
316	4-Ethoxybenzoic acid	198 195 6			169, 170 172			202			
317	<i>trans</i> -3-Nitrocinnamic acid	199 <i>cis</i> 138				174	178, 173	196			
318	Chrysodiphenic acid (2-Phenyl-naphthalene-1,2'-dicarboxylic acid)	199						1- <i>mono</i> 275, 2'- <i>mono</i> 220	1- <i>mono</i> 171 5, me al, 2'- <i>mono</i> 124, <i>di</i> 90		
319	3,4-Dihydroxybenzoic acid (Protocatechuic acid)	199-200d			166	188		212	134 5 w		
320	3-Hydroxybenzoic acid	200, subl		163 dil al	156 7, w 155	106 8	176, 176 1-4	170 167 w			
321	Phthalic acid (Benzene-1,2-dicarboxylic acid)	200 6, 191 (sealed tube), 230 (rapid htng )		<i>mono</i> 150 (slow htng ), 160 5 (rapid htng ), <i>di</i> 201	<i>mono</i> 170 <i>di</i> 253-5	<i>di</i> 155 5	<i>di</i> 152 8	<i>mono</i> 149, <i>di</i> 220			
322	3,4-Dichlorobenzoic acid	201 2, 208 9						133			
323	(4-Chloromethyl)benzoic acid	203						173			Nitrile, 79 80, al, b p 263
324	5-Bromo-2-nitro-4-toluic acid (2-Bromo-4-methyl-5 nitro-benzoic acid)	203, 200						191		61	Nitrile, 132
325	4-Bromo-3-nitrobenzoic acid	203 4			156, or -yel, al			156	104	74	Nitrile, 120
326	<i>d,l</i> -Tartaric acid	203-4 (+1 H <sub>2</sub> O) 205 6 (anh )			<i>di</i> 235-6	<i>di</i> 147 6		<i>di</i> 226, w-me al			
327	<i>cis</i> -Apocamphoric acid	204, w, <i>trans</i> 190-1, w			<i>mono</i> 212						Anhydride, 178, al
328	3,5-Dinitrobenzoic acid	204-5			234	157	159	183			

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	<i>p</i> -Toluidide	Antide	<i>p</i> -Nitrobenzyl ester	<i>p</i> -Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
329	Mesaconic acid (Methylfumarc acid)	204 5 (cor), subl		<i>mono</i> (α) 196, <i>di</i> 212, al	<i>mono</i> (α) 202, <i>mono</i> (β) 163, <i>di</i> 185 7	<i>di</i> 134 (cor)		<i>mono</i> (α) 222, <i>mono</i> (β) 174, <i>di</i> 176 5			
330	5-Bromo-3-nitro-4-toluic acid (6-Bromo-4-methyl-2-nitrobenzoic acid)	206						171			Nitrile, 130, subl
331	Anthracene-9-carboxylic acid ( <i>meso</i> -Anthroic acid)	207, pa yel, al							111, yel		Nitrile, 170-2, lgr
332	Vanillic acid	207, 210				140d				44, b p 293	
333	<i>trans</i> -2-Coumaric acid ( <i>trans</i> -2-Hydroxycinnamic acid)	207 8d, subl, w				152 5		209d			Acetate, 154 5, 146, bz
334	Oxamic acid	210			148-9			419d			
335	Pentamethylbenzoic acid	210						206			
336	4-Coumaric acid (4-Hydroxycinnamic acid)	210 3, 206 (anh)						194	137 126		Acetate, 200 5
337	<i>trans</i> -2-Chlorocinnamic acid	212, yel, al			176			168	10 5, b p 278-9	b p 162 <sup>12</sup>	Nitrile, 40
338	2,4-Dihydroxybenzoic acid (β-Resorcylic acid)	213d (rapid htng), 216d, 217			126-7	188 9		222			Loses H <sub>2</sub> O of crystallization at 100 Easy loss of CO, gives m p varying from 194 to 236
339	2-Bromo-3,5-dinitrobenzoic acid	213						216, pa yel, al -w 212	109, me al -w	74, al	
340	4-Dibenzofurylacetic acid	214						212			
341	Mucic acid	214d (varies with htng rate) 223 255				310	225	<i>mono</i> 192d, <i>di</i> 220			
342	3-Chloroanisic acid (3-Chloro-4-methoxybenzoic acid)	214 5						193	94 5		
343	4-Hydroxybenzoic acid	215, 213-4 210		203-4, al	196 7, yel, w	180 2	191 5 (cor), 184	162 (+1 H <sub>2</sub> O), w			
344	Piperic acid	216				145					
345	3-Chloro-2-naphthoic acid	216 7, me al -w						237	58, me al	50	
346	3-Nitrophthalic acid	218		<i>di</i> 226	<i>di</i> 234	189		<i>di</i> 201d 198			
347	Acenaphthene-5-carboxylic acid	219, bz						223			Nitrile, 110-1
348	4-Cyanobenzoic acid (Terephthalic acid mononitrile)	219, 214			179	189			62	54	
349	4-Phenylbenzoic acid	221						223			
350	3-Hydroxy-2-naphthoic acid	222 3 (cor)		221-3	243-4, ac a, 249 (cor)			217 8 (cor), yel, al			

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	<i>p</i> Toluidide	Anilide	<i>p</i> Nitro benzyl ester	<i>p</i> -Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
351	4-Hydroxy-2-naphthoic acid	225 6		206				217 8			Nitrile, 106-7, subl
352	5-Bromo-3-nitro-2-toluic acid (4-Bromo-2-methyl 6 nitro-benzoic acid)	226						235			
353	9-Fluorenicarboxylic acid	227 230, 225						251			
354	Biphenyl-2,2'-dicarboxylic acid (2 2 Diphenic acid)	227 233 229			mono 176, di 229-30, al	di 187, 182 6		mono 193, 190 1, di 212, w			
355	Methyliminodiacetic acid	227d						mono 169, di 169			
356	2,4,6-Trinitrobenzoic acid	228						264d			
357	Piperonylic acid	229, 228						169, al			
358	5-Nitrosalicyclic acid	229 30			224			225			
359	4-Chloro-3-hydroxy-2-naphthoic acid	231, yel						225	116, yel		
360	1-Phenanthroic acid	232						284			
361	3-Pyridylacrylic acid	233						148			
362	4-Bromo-3-hydroxy-2-naphthoic acid	233-5d, yel, al - ac a			161-2						Acetate, 183
363	4-Chloro-1-hydroxy-2-naphthoic acid	234, al		143-4	180-1				120-1	92-3	<i>o</i> -Toluidide, 148-9, <i>m</i> -Toluidide, 188-9
364	3-Chloro-2-nitrobenzoic acid	235 w			186						
365	Benzophenone-2,4-dicarboxylic acid	235, w						di >288	di 107		
366	5-Bromo-2-hydroxy-3-toluic acid (5 Bromo-2-hydroxy 3-methylbenzoic acid)	236			125, al -w			75-8	109	75	
367	2-Thianaphthenecarboxylic acid	236						177			
368	Butane-1,2,3,4-tetracarboxylic acid (high melting form)	236-7 (slow htng )			di 168, acet (slow htng )			di 169d	tetra 63-4, lgr		Di-imide, 320d, w
369	7-Bromo-1-naphthoic acid	237 (cor ), 60% al			202, al -w			247, 50% al	55 (cor ), 60% me al	46	
370	3-Pyridinecarboxylic acid	237 8 235, 232		150	85, 132, bz - lgr, 265, w			128, 122			
371	<i>trans</i> -2-Nitrocinnamic acid	240, <i>cis</i> 146-7				132	141	185			
372	2-Chloroquinoline-3-carboxylic acid	240						200-1			
373	4-Nitrobenzoic acid	241		204, 192	211, 204	168	137	201, 198	96	57	
374	Azobenzene-4-carboxylic acid	241, red, al						224-5, red	123-4, or, me al	86-7, or - red, al	Nitrile, 120-1, br, bz, Propyl ester, 64, red, lgr
375	4-Chlorobenzoic acid	243, 240			194, al	129 5, al	126	179, 170	44	b p 238	
376	7-Chloro-1-naphthoic acid	243, 60% al			185, al -w			237, 50% al	54, 60% al		
377	3-Chlorocinchonic acid (2-Chloroquinoline-4-carboxylic acid)	244, al			202, al			334-5, al -w, 276-8 (after fusion)	89-90, acet	64 5	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point °C	<i>p</i> -Toluidide	Anilide	<i>p</i> -Nitrobenzyl ester	<i>p</i> -Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
378	5-Chloro-1-naphthoic acid	245, 241-2 subl						239		42	Nitrile, 145
379	Azobenzene-2,2'-dicarboxylic acid	245, dk yel, al						<i>mono</i> 215d, red-br, et ac, <i>di</i> 294d, red-br, ac a 260, al	<i>di</i> 101, red, me al	<i>di</i> 85, pa red, al	
380	Anthracene-1-carboxylic acid ( $\alpha$ -Anthroic acid)	245, yel, al, 252							108, ac a		Nitrile, 126, yel, Phenyl ester, 207-9, yel
381	2-Amino-9,10-anthraquinone-1-carboxylic acid	250 2, or - red						300, or, PhNO <sub>2</sub>			
382	4-Bromobenzoic acid	251-3			197	180		189-90, w			<i>p</i> -Phenylphenacyl ester, 193
383	9-Phenanthroic acid	251, 253						233			
384	4-Bromocinnamic acid	251 3			183				80		
385	Cinchonic acid (Quinoline-4-carboxylic acid)	253 4 (+1 or 2H <sub>2</sub> O)						181	24	13, b p 173 <sup>15</sup>	Nitrile, 102
386	Gallic acid (3,4,5-Trihydroxybenzoic acid)	253-4d, 222-40d			207	141	134	189			
387	1-Acenaphthoic acid	256						228			
388	2-Phenanthroic acid	260						243			
389	Cinchomeric acid (Pyridine-3,4-dicarboxylic acid)	260d, w			<i>di</i> 199- 206			3- <i>mono</i> 200d, 4- <i>mono</i> 170d, w, <i>di</i> 163-5d	3- <i>mono</i> 182 4- <i>mono</i> 154-72, <i>di</i> 141	4- <i>mono</i> 131-3, bz, <i>di</i> b p 172 <sup>21</sup>	Imide, 229-30, subl
390	5-Bromo-1-naphthoic acid	261, 256						241		48-9	Nitrile, 147, subl
391	Chelidonic acid ( $\gamma$ -Pyrone-2,6-dicarboxylic acid)	262						245	<i>di</i> 122 5	227, <i>di</i> 63	<i>p</i> -Phenylphenacyl ester, 195-8d
392	4-Iodobenzoic acid	270, 265			210	141	146	217			
393	5-Chloro-2-naphthoic acid	270, al			202 5			186-7	81	45	Nitrile, 144
394	3-Phenanthroic acid	270						234			
395	Quinoline-3-carboxylic acid	272						198			
396	1-Chloroanthraquinone-2-carboxylic acid	272, pa yel, al			248 9, pa yel, bz - ac a			317, yel	161 5, yel, acet, 155	142, yel, al	Benzyl ester, 135- 6, yel, al
397	Anthracene-2-carboxylic acid ( $\beta$ -Anthroic acid)	281, yel, al						293-5, yel, al		134-5	
398	<i>trans</i> -4-Nitrocinnamic acid	285				186	191	204, 217			
399	Fumaric acid ( <i>trans</i> -Butanedioic acid)	286-7, (sealed tube), >200, subl, 293-5			<i>mono</i> 233 0- 4 5, <i>di</i> 313 4, ac a	150 8		270, 300 2 subl, <i>di</i> 266d	<i>di</i> 102, b p 192	<i>mono</i> 66, <i>di</i> b p 218	At 230 $\rightarrow$ maleic anh 56
400	Muconic acid	289d (slow htng), 306 (rapid htng)						<i>di</i> 240d			<i>trans-trans</i> 296- 8, <i>cis-cis</i> 195

\* Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	<i>p</i> Toluidide	Amide	<i>p</i> -Nitro benzyl ester	<i>p</i> -Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
401	<b>9,10-Anthraquinone-2-carboxylic acid</b>	290-2, yel, ac a			258 60			280, ac a -bz	170	147	
402	<b>9,10-Anthraquinone-1-carboxylic acid</b>	293 4, pa yel, ac a			288 9, pa yel, PhNO <sub>2</sub>			280 pa yel, al	189, pa yel, me al	169, yel, al	Nitrile, 247, yel, ac a
403	<b>Bromoterephthalic acid</b> (2-Bromobenzene-1,4-dicarboxylic acid)	299						<i>di</i> 270	1- <i>mono</i> 145, 4- <i>mono</i> 164 <i>di</i> 54		
404	<b>Terephthalic acid</b> (Benzene-1,4-dicarboxylic acid)	300, subl without melting > 300, w			<i>di</i> 334 7, PhNO <sub>2</sub>	<i>di</i> 263 5	<i>di</i> 225	<i>di</i> >225			
405	<b>Chloroterephthalic acid</b> (2-Chlorobenzene-1,4-dicarboxylic acid)							<i>di</i> > 300	<i>di</i> 60		
406	<b>4-Pyridinecarboxylic acid</b> (Isonicotinic acid)	324						156			
407	<b>9,10-Anthraquinone-2,3-dicarboxylic acid</b>	240-2, yel, ac a						<i>mono</i> >340, br, ac a			Anhydride, 290
408	<b>Isophthalic acid</b> (Benzene-1,3-dicarboxylic acid)	348, subl				202 5	179 1	<i>mono</i> 280, <i>di</i> 280			Ba salt (+ 6 H <sub>2</sub> O) very soluble—differentiates from Terephthalic acid Dinitrile, 204-5
409	<b>Benzophenone-4,4'-dicarboxylic acid</b>	subl <360						<i>di</i> > 300	<i>di</i> 224 231		
410	<b>Trimesic acid</b> (Benzene-1,3,5-tricarboxylic acid)	380 (cor)			<i>tri</i> 118-20d, ac a		<i>tri</i> 197 (sealed tube)	365d (cor)	<i>tri</i> 143-4, me al	<i>tri</i> 132 3, al 133 after sintering at 127	

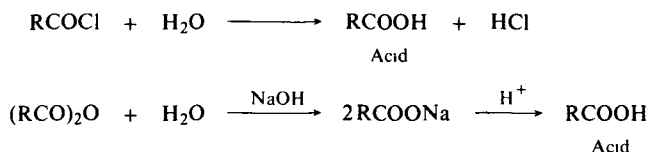
\* Derivative data given in order m p, crystal color, solvent from which crystallized



## EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV

The derivatives of three classes of compounds (carboxylic acids, acyl halides and acid anhydrides) are essentially the same as those of carboxylic acids, and are prepared either directly from the acid or *via* the acyl halide. All of them appear therefore under the same title.

*Hydrolysis of acid halide or acid anhydride to the corresponding carboxylic acid*



From the acyl halide in water

*For directions and examples see* Wild, p 180

From the acyl halide with aqueous sodium hydroxide

*See* Vogel, p 369, Wild, p 180

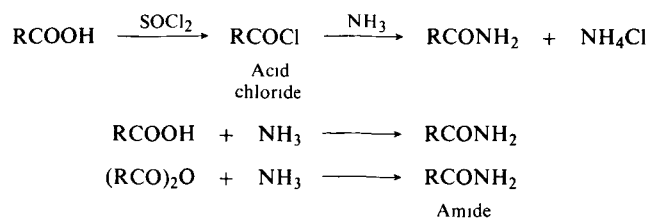
From the acid anhydride with water

*See* Vogel, p 376, Wild, p 184, A C D Rivett and N V Sidgwick, *J Chem Soc*, **97**, 1677 (1910)

From the acid anhydride with aqueous sodium hydroxide

*See* Linstead, pp 16-7 Wild, p 184

*Amide \**



Acid chloride is prepared from the acid and thionyl chloride. Amide is formed on addition of aqueous ammonia.

*For directions and examples see* Cheronis, p 440, Shriner, p 200, Vogel, p 361, Wild, p 181

From the acid chloride in benzene with aqueous ammonia

*See* D Swern, J M Stutzman and E T Roe, *J Amer Chem Soc*, **71**, 3017 (1942)

By passing gaseous ammonia through a benzene or ether solution of the acyl chloride

*See* Linstead, p 14, Wild, p 182

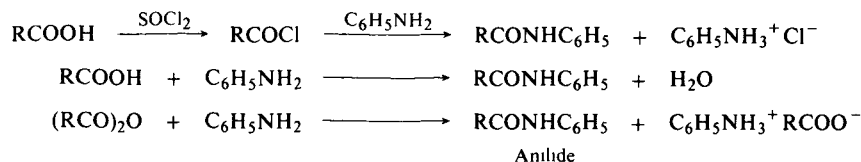
From the neat acid with gaseous ammonia

*See* J A Mitchell and E E Reid, *J Amer Chem Soc*, **53**, 1879 (1931)

From the acid anhydride with aqueous ammonia

*See* Wild, p 184, 185

*Anilide \**



From the acid chloride (prepared from the acid and thionyl chloride) and aniline in benzene or in ether

*For directions and examples see* Cheronis, p 445, Linstead, p 14, Shriner, pp 98, 200-1, Vogel, pp 361, 369, 458, Wild, p 182, P W Robertson, *J Chem Soc*, **115**, 1210 (1919)

From the acid chloride with aniline in aqueous sodium hydroxide

*See* Wild, pp 181, 219

From the acid and aniline at high temperatures

*See* Vogel, p 362

\*Derivatives recommended for first trial

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives.

EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV (Continued)

From the sodium salt of the acid with aniline and concentrated hydrochloric acid

See Shriner, p 201, Wild, p 154

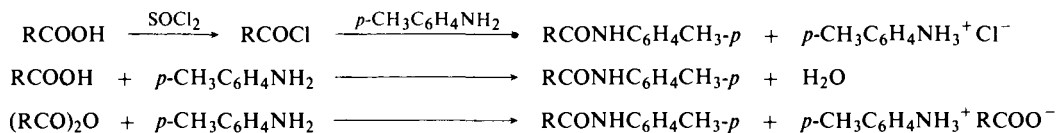
From the acid anhydride with aniline without solvent

See Linstead, p 17, Vogel, p 377, Wild, p 185

From the acid anhydride with aniline in benzene

See Linstead, p 15, Wild, p 185

*p*-Toluidide \*



From the acid chloride with *p*-toluidine in ether or benzene

For directions and examples see Cheronis, pp 441, 444, 458, Linstead, p 14, Shriner, pp 200-1, Vogel, p 361

From the acid and *p*-toluidine at high temperatures

See Cheronis, pp 441, 442-3, Vogel, p 362

From the sodium salt of the acid, *p*-toluidine and concentrated hydrochloric acid

See Shriner, p 201, Wild, p 154

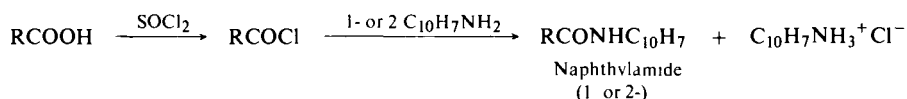
From the acid anhydride with *p*-toluidine without solvent

See Cheronis, p 459, Linstead, p 17

From the acid anhydride with *p*-toluidine in benzene

See Wild, p 185

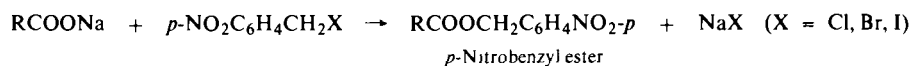
1- and 2-Naphthylamide \*



From the acid chloride with the naphthylamine

For directions and examples see Cheronis, p 446, P W Robertson, *J Chem Soc*, 115, 1210 (1919)

*p*-Nitrobenzyl ester \*



From an aqueous solution of the sodium salt of the acid, with the *p*-nitrobenzyl halide in ethanol

For directions and examples see Cheronis, pp 447, 448, Shriner, p 200, Vogel, p 362, Wild, pp 144-5

From an aqueous solution of the sodium salt of the acid with *p*-nitrobenzyl bromide in acetone

See F F Blicke and F D Smith, *J Amer Chem Soc*, 51, 1947 (1929)

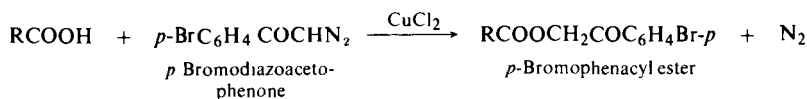
From the sodium or the potassium salt of the acid and *p*-nitrobenzyl bromide in 1:2 water-ethanol

See E E Reid, *J Amer Chem Soc*, 39, 124 (1917)

From the sodium or the potassium salt of the acid and *p*-nitrobenzyl chloride or iodide in 1:2 water-ethanol

See J A Lyman and E E Reid, *J Amer Chem Soc*, 39, 701 (1917)

*p*-Bromophenacyl ester \*



From the sodium salt of the acid and *p*-bromophenacyl bromide in aqueous ethanol

\*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives



## EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV (Continued)

From the acid chloride and ethanol.

See: Vogel, p. 389.

NOTE: The same methods can be used for the formation of other esters.

### *S-Benzylthiuronium salt.\**



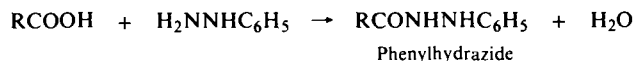
From the sodium or the potassium salt of the acid and S-benzylthiuronium chloride in water.

For directions and examples see: Linstead, p. 15; Vogel, p. 36; Wild, p. 149; S. Veibel and H. Lillelund, *Bull. Soc. Chim.* [5], 5, 1153 (1938), S. Veibel and K. Ottung, *Bull. Soc. Chim.* 6, 1434 (1939).

From the sodium or the potassium salt of the acid in water or in aqueous ethanol with an ethanolic solution of S-benzylthiuronium chloride.

See: Cheronis, p. 449; Shriner, p. 202; J. J. Donleavy, *J. Amer. Chem. Soc.*, 58, 1004 (1936).

### *Phenylhydrazide.*



From the acid with phenylhydrazine without solvent.

For directions and examples see: Shriner, p. 201; Wild, p. 152; G. H. Stempel and G. S. Schaffel, *J. Amer. Chem. Soc.*, 64, 470 (1942).

From the acid with phenylhydrazine in benzene.

See: Shriner, p. 201; Wild, p. 152.

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

I. Acyl Fluorides (Listed in order of increasing b.p.)\*

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	<i>p</i> -Toluidide	2-Naphthyl amide	Miscellaneous
						B p, °C	M p, °C					
1	Acetyl fluoride	20-1			1.002 <sup>15</sup>	118		82	114	147	134	
2	Propionyl fluoride	44.6				141		81	106	126		
3	Fluoroacetyl fluoride	50.5-51				167.9	31-2	108				
4	Trichloroacetyl fluoride	66.8				197	57.8	141	97	113		
5	<i>n</i> -Butyryl fluoride	67				162.5		115	96	75	125	
6	Chloroacetyl fluoride	73.5					63	120	137	162	117.8	
7	Phthaloyl difluoride	224.6	42-3				206	220( <i>dt</i> )	253( <i>dt</i> )	201( <i>dt</i> )		
8	Phenylacetyl fluoride	88-9 <sup>17</sup>					76	156	118	136	159	

\* Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES  
II. Acyl Chlorides a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	p-Toluidide	2-Naphthyl amide	Miscellaneous
						B p., °C	M p., °C					
1	Acetyl chloride	51-2		1.3897 <sup>20</sup>	1.1054 <sup>20</sup>	118		82	114	147	134	
2	Oxalyl chloride	64	-12	1.434 <sup>13</sup>	1.488 <sup>13,4</sup>		101 (dihyd)	419d	246	268		
3	Fluoroacetyl chloride	72-3				167.9	31-2	108				
4	Acrylyl chloride	76		1.4343 <sup>20</sup>	1.1144 <sup>20</sup>	140		85	105	141		
5	Propionyl chloride	80		1.4051 <sup>20</sup>	1.0652 <sup>20</sup>	141		81	106	126		
6	Isobutyryl chloride	92		1.4079 <sup>20</sup>	1.0174 <sup>20</sup>	154.5		128	105	107		
7	Methacrylyl chloride	95-6		1.4435		160.5	15-6	102-6				
8	Vinylacetyl chloride	98				163		72-3	58			
9	n-Butyryl chloride	101-2		1.4121 <sup>20</sup>	1.0284 <sup>20</sup>	162.5		115	96	75		
10	Pivalyl chloride	105-6					35	154	129	120		
11	Dichloroacetyl chloride	108				194		98	118	153		
12	Chloroacetyl chloride	108-10		1.454 <sup>20</sup>	1.3997 <sup>18</sup>	189	63	120	137	162		
13	DL-α-Chloropropionyl chloride	110-11		1.440 <sup>20</sup>	1.2854 <sup>20</sup>	185-6		80	92	124		
14	Methoxyacetyl chloride	113				204		97	58			
15	DL-Ethylmethacetyl chloride	115-6				176		112	110	93		
16	Isovaleryl chloride	115		1.4136 <sup>24,3</sup>	0.9854 <sup>24,3</sup>	176		135	109.10	107	138.5	
17	Acetylglycyl chloride	115-8					206	137				Hydrazide 115 Me ester 58.9
18	Trichloroacetyl chloride	118		1.470 <sup>20</sup>	1.6204 <sup>20</sup>	197	57.8	141	97	113		
19	Cyclopropane carbonyl chloride	120			1.1523 <sup>0</sup>	186	18	125				
20	Ethoxyacetyl chloride	123-4				207		80.2				
21	trans-Crotonyl chloride	126		1.46 <sup>18</sup>	1.082 <sup>20</sup>		72	161	118	132		
22	n-Pentanoyl chloride (n-Valeryl chloride)	126		1.420 <sup>20</sup>	1.0004 <sup>20</sup>	186		106	63	74	112	
23	Allylacetyl chloride	128			1.074 <sup>16</sup>	188.9		94				
24	Bromoacetyl chloride	133-5			1.908 <sup>0</sup>	208	50	91	131		134	
25	Cyclobutane carbonyl chloride	137 142.3				195		153				
26	β-Methoxypropionyl chloride	138		1.424		107 <sup>10</sup>		50.5				
27	Diethylacetyl chloride	140		1.4234		190		107				
28	β-Chloropropionyl chloride	144		1.455	1.331 <sup>13</sup>		42		119	121		
29	Isocaproyl chloride (4-Methylpentanoyl chloride)	147			0.9725 <sup>20</sup>	199		121	112	63		
30	α-Acetoxypionyl chloride (O-Acetyl lactoyl chloride)	150 part d		1.4241 <sup>17</sup>	1.192		57.60, 40					
31	DL-α-Bromobutyryl chloride	150-2				217d	-4	112	98	92		
32	n-Hexanoyl chloride (n-Caproyl chloride)	153		1.426 <sup>20</sup>	0.975 <sup>20</sup>	205		100	95	75	107	
34	Furoyl chloride	173.4					133-4	142-3	124	107		
35	n-Heptanoyl chloride (Enanthoyl chloride)	175		1.4345 <sup>15</sup>	0.9632 <sup>20</sup>	223		96	70(65)	81	101	
36	Hexahydrobenzoyl chloride (Cyclohexane carboxylic acid chloride)	183.4		1.4766 <sup>15</sup> 1.4711 <sup>20</sup>	1.0964 <sup>15</sup>		29.30	185	143.4			
37	3-Fluorobenzoyl chloride	189, 204					124	130				
38	Succinyl dichloride	190d	20	1.473 <sup>15</sup>	1.3954 <sup>15</sup>		186	260 (di)	230 (di)	255 (di)		
39	4-Fluorobenzoyl chloride	193	9				183	154.5				

\*Derivative data given in order m p., crystal color, solvent from which crystallized

**TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES**  
**II. Acyl Chlorides a) Liquids I) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	p-Toluidide	2-Naphthyl amide	Miscellaneous
						B p. °C	M p. °C					
40	<i>n</i> -Octanoyl chloride ( <i>n</i> -Capryloyl chloride)	196			0.949 <sup>20</sup>	239	16	110, 106	57	70	103	
41	Benzoyl chloride	197	-1	1.558 <sup>15</sup>	1.212 <sup>20</sup>		122	130	163	158		
42	Diethyl malonyl dichloride	197		1.5537 <sup>20</sup>	1.2187 <sup>15</sup>		125	224 ( <i>dt</i> )				
43	2-Fluorobenzoyl chloride	206	4				126.5	116				
44	Phenylacetyl chloride	210		1.533 <sup>20</sup>	1.1685 <sup>20</sup>		76	156	118	136	159	
45	<i>n</i> -Nonanoyl chloride (Pelargonyl chloride)	215			0.946 <sup>15</sup>	255	12	99	57	84	103	
46	Glutaryl dichloride	218		1.473 <sup>20</sup>	1.324 <sup>20</sup>	302	97.8	175.6 ( <i>dt</i> )	224			
47	4-Chlorobenzoyl chloride	222	16	1.579 <sup>20</sup>	1.362 <sup>20</sup>		240	179, 170	194			
48	Hydrocinnamoyl chloride ( $\beta$ -Phenylpropionyl chloride)	225 d			1.135 <sup>21</sup>		48	105	98, pet eth	135		
49	3-Chlorobenzoyl chloride	225					158	134	122			
50	Phenoxyacetyl chloride	225-6					98-9	101.5	101			
51	4-Methylbenzoyl chloride (4-Toluyyl chloride)	225.6	-3.9	1.545 <sup>20</sup>	1.1686 <sup>20</sup>		179-80	160	145	160		
52	<i>n</i> -Decanoyl chloride	232				268.70	31	108.98	70	78	104	
53	2-Chlorobenzoyl chloride	233					142	142	118	131		
54	3-Methoxybenzoyl chloride	242.4					110, 105					Benzylamine salt of acid, 112 Hydrazide, 151
55	3-Bromobenzoyl chloride	243, 239					155	155	136			
56	2-Bromobenzoyl chloride	245	11				150	155.6	141			Hydrazide, 153
57	2-Methoxybenzoyl chloride	254						129	131			Phenyl ester, 59
58	4-Methoxybenzoyl chloride (Anisoyl chloride)	262.3 sl d	22	1.58 <sup>20</sup>	1.261 <sup>20</sup>		184	162.3	169, 163	186		Aniside, 202
59	Phthaloyl dichloride	276	15.6	1.569 <sup>20</sup>	1.406 <sup>20</sup>		200.6	220 ( <i>dt</i> )	253.5 ( <i>dt</i> )	201 ( <i>dt</i> )		
60	3-Nitrobenzoyl chloride	278	35				140	143	154	162		
61	1-Naphthoyl chloride	297.5	20				161	202				Piperidide, 85.7

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES**  
**II. Acyl Chlorides a) Liquids**  
**2) (Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amides)\***

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	p-Toluidide	2-Naphthyl amide	Miscellaneous
						B p °C	M p, °C					
1	$\beta$ -Ethoxypropionyl chloride	78 <sup>52</sup>				120 <sup>17</sup>		51				
2	Azidoacetyl chloride	50 <sup>20</sup>					16	58				
3	Oleyl chloride	163 <sup>2</sup>					16	75.6	41	42.5		
4	$\gamma$ -Phenoxybutyryl chloride	155 <sup>20</sup>					64-5	80				
5	$\gamma$ -Phenylbutyryl chloride	140-2 <sup>12</sup>				290	60	84.5				
6	$\omega$ -Undecenoyl chloride ( $\omega$ -Undecylenoyl chloride, $\omega$ -Hendecenoyl chloride)	128 <sup>14</sup>				275	52	87				
7	Benzoylformyl chloride	125 <sup>9</sup>					64-6	91				2,4-Dinitrophenyl-hydrazone of acid, 196.7, yel
8	Iodoacetyl chloride	49-52 <sup>15</sup>			2.25 <sup>25</sup>		83	95	143-4			
9	$\beta$ -Iodopropionyl chloride	81 <sup>15</sup>					82, 85	101, 142				
10	Palmitoyl chloride	194 <sup>17</sup>	11-2				63	106-7	90	98	109	
11	Myristoyl chloride	174 <sup>16</sup>	1-3				54, 58	107	84	93	108	
12	Phenylpropionyl chloride	115-6 <sup>17</sup>					136-7	108-9, 99, 100	126	142		
13	Dodecanoyl chloride (Lauroyl chloride)	145 <sup>18</sup>	-17	1.446 <sup>20</sup>		299	44	110, 102	78	87	106	
14	$\alpha$ -Phenoxybutyryl chloride	128-31 <sup>38</sup>				258	82.3	111, 123	93-4			Phenyl ester, 48-9
15	Cyanoacetyl chloride	57 <sup>9, 5</sup>					99	119, 20	198-9			
16	Nicotinyl chloride	90 <sup>15</sup>					66	122	85			
17	Dibenzylacetyl chloride	202 <sup>18</sup>					235	129	155			
18	$\alpha$ -Phenoxypropionyl chloride	115 <sup>20</sup>					89	132	117	115	117	
19	DL- $\alpha$ -Bromoisovaleryl chloride	59 <sup>15</sup>					115.6	133	116	124	145	
20	3-Ethoxybenzoyl chloride	135-40 <sup>16</sup>	27.8				112.3	137	139			
21	$\alpha$ -Bromoisobutyryl chloride	52 <sup>30</sup>		1.475 <sup>23</sup>			44	148	83	92.5	135	
22	4-Isopropylbenzoyl chloride	121 <sup>10</sup>					48.9	153				
23	Benzilic acid chloride ( $\alpha$ -Hydroxydiphenylacetyl chloride)	193.5 <sup>27</sup>					256-8	154.5	175	190		Me ester 74-5
24	1-Naphthoxyacetyl chloride	194 <sup>10</sup>					150	155	144			4-Phenetidine, 145.6
25	Hexahydrophenylacetyl chloride (Cyclohexylacetyl chloride)	98, 100 <sup>23</sup>				244-6	190	171-2				
26	Azelayl dichloride	166 <sup>14</sup> , 140 <sup>11, 1</sup>					33	175 (dl)	186-7 (dl)	191 (dl)		
27	2-Nitrobenzoyl chloride	148 <sup>9</sup>	20				146	176	155			
28	Mesaconyl dichloride (Methylfumaryl dichloride)	64-5 <sup>14</sup>					240.5	177 (dl)	186 (dl)	212		
29	1-Naphthylacetyl chloride	188 <sup>23</sup>					131	180.1				
30	2,4,6-Trimethylbenzoyl chloride	155-6 <sup>18</sup>		1.5263 <sup>23</sup>	1.0967 <sup>25</sup>		154	188				
31	3-Formylbenzoyl chloride	130 <sup>20</sup>					152	190				Me ester, 53, Semicarbazone of acid, 265
32	4-Ethoxybenzoyl chloride	160 <sup>20</sup>					175					
33	Sebacoyl dichloride	182 <sup>15</sup>		1.4684	1.1212 <sup>20</sup>		198	202	170			
							134.5	210 (dl)	198 (dl)			

\*Derivative data given in order m p, crystal color, solvent from which crystallized



TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

H. Acyl Chlorides a) Liquids

2) (Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amides)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	p-Toluidide	2-Naphthyl amide	Miscellaneous
						B p, °C	M p, °C					
34	Adipyl dichloride	130-2 <sup>18</sup>					153	220 (di)	240-1	241		Di-N-methyl-amide, 152-3
35	Benzylmalonyl dichloride	141 <sup>15</sup>					117d	225 (di)	217 (di)			Di-Me ester, 51
36	Phenylmalonyl dichloride	122 <sup>15</sup>					152-3	233				
37	trans-Aconityl trichloride (1,2,3-Propylenetricarboxylic acid trichloride)	155-7 <sup>20</sup>					194-5	260 (tri) (sinters)				
38	Fumaryl dichloride	63 <sup>13</sup>		1 5004 <sup>18</sup>	1 408 <sup>20</sup>		300-2	266 (di)	314 (di)			

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES**  
**II. Acyl Chlorides b) Solids (Listed in order of increasing m.p.)\***

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Amilide	p-Toluidide	2 Naphthyl amide	Miscellaneous
						B p, °C	M p °C					
1	Salicyloyl chloride	92 <sup>15</sup>	19-20				158	142	136	156	189	
2	Stearoyl chloride	202-3 <sup>6</sup>	23				70 1	109	95	102	112	
3	2-Iodobenzoyl chloride		35-40, 30-1				162	184				
4	trans-Cinnamoyl chloride	258	35 6	1 6202 <sup>37</sup>	1 1632 <sup>37</sup>		133	147 8	151	168		
5	4-Bromobenzoyl chloride	245-7	42				251 3	189-90	197			Hydrazide, 164
6	Isophthaloyl dichloride	276	43-4	1 570 <sup>47</sup>	1 388 <sup>47</sup>		345-7	280 (di)				Di-Me ester, 68 Dihydrazide, 220 Piperidide, 88-90 Me ester, 70
7	2-Naphthoyl chloride	304-6	43				184-5	192				Piperidide, 88-90 Me ester, 70
8	2,4-Dinitrobenzoyl chloride		46				183	203				Me ester, 63, Phenylhydra- zone of acid, 226
9	4-Formylbenzoyl chloride	258	48				256					
10	4-Nitrophenylacetyl chloride		48				153	198	198			
11	2-Naphthoxyacetyl chloride		54				156	147	145			4-Phenetidide, 164-5, Et ester, 48-9
12	Diphenylacetyl chloride		56-7				148	168	180	173	191 2	
13	trans-2-Nitrocinnamoyl chloride		64 5				240	185				Me ester, 73
14	3,5-Dinitrobenzoyl chloride		68 9, 74				204 5	183	234			Me ester, 108, Et ester, 93
15	4-Nitrobenzoyl chloride	150-2 <sup>15</sup>	75				241	201	211	204		
16	3-Nitrophthaloyl dichloride		77				218	201 (di)	234 (di)	226 (di)		
17	Benzylidene malonyl dichloride		77				195-6	189 (di)				Di Me ester 45
18	Fluorene-9-carboxylic acid chloride		77				230-2	251				Me ester, 63
19	Terephthaloyl dichloride		83-4					>250 (di)	334-7 (di)			Di-l-naphthyl- amide, 334
20	4-Iodobenzoyl chloride		83 77-8				270 265	218	210			
21	Diphenylcarbonyl chloride (Diphenylaminoformyl chloride)		86					189				Me ester, 86, Et ester, 72, lgr
22	2,2'-Diphenic acid dichloride		94				228 9	212				
23	α,α-Diphenylpropionyl chloride		95-6				173-4	149				Benzyl ester, 71 2
24	Phenanthrene-2-carboxylic acid chloride		101				259 60	242 3	217-8			
25	Phenanthrene-9-carboxylic acid chloride		102				252	232 226	218			
26	Diphenyl-4-carbonyl chloride (4-Phenylbenzoyl chloride)		114-5				228	223				Me ester, 117-8, Et ester, 46
27	Phenanthrene-3-carboxylic acid chloride		116-7				269	233 227	216-7			
28	trans-4-Nitrocinnamoyl chloride		124				286	217				Me ester, 161
29	Fluorenone-4-carboxylic acid chloride		128, yel				227, yel	230, 225				Oxime of acid, 263, Me ester, 132, Et ester, 103
30	Fluorenone-1-carboxylic acid chloride		140, yel					229-30				Oxime of acid 230 Me ester, 86 9, Et ester, 84 6

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES**  
**II. Acyl Chlorides b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	p-Toluidide	2-Naphthyl amide	Miscellaneous
						B p, °C	M p, °C					
31	Azobenzene-4,4'-dicarboxylic acid dichloride		144-5, red				330d					Di-Me ester, 242, Di-Et ester, 146 Me ester, 170
32	9,10-Anthraquinone-2-carboxylic acid chloride		147				290, yel	280	258-60			
33	Di-(1-naphthyl) acetyl chloride		167-9				228.5					
34	9,10-Anthraquinone-2,6-dicarboxylic acid dichloride		197-8				>400	>370				
35	9,10-Anthraquinone-1,4-dicarboxylic acid dichloride		203-5				>300					
36	9,10-Anthraquinone-1,5-dicarboxylic acid dichloride		260-3				>390					

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES**  
**III. Acyl Bromides a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	p-Toluidide	2-Naphthylamide	Miscellaneous
						B p, °C	M p °C					
1	Oxalyl dibromide	64					101 (hyd)	419d (dr)	254 (dr)	268 (dr)		
2	Acetyl bromide	81		1.4538 <sup>18</sup>	1.6625 <sup>16</sup>	118		82	114	147	132	
3	Propionyl bromide	103				141		81	106	126		
4	Chloroacetyl bromide	127					63	120	137	162	117-8	
5	n-Butyryl bromide	128				162.5		115	96	75	125	
6	Isovaleryl bromide	138-40				176		135		107	138.5	
7	Trichloroacetyl bromide	143			1.90 <sup>13</sup>	197	57-8	162.5	95-7	113		4-Nitroanilide, 146-7
8	Bromoacetyl bromide	150			2.425	208	50	91	131		134	
9	DL-α-Bromopropionyl bromide	154-5			2.061 <sup>16</sup>	204	25.7	123	99, 110			
10	α-Bromoisobutyryl bromide	162-4				198-200	48.9	148	83	92.5	135	
11	DL-α-Bromobutyryl bromide	172.4				127 <sup>25</sup>	-4	112, 108				
12	n-Hexanoyl bromide (n-Caproyl bromide)	175-6				205		100	95	75	107	
13	DL-α-Bromoisovaleryl bromide	184-94					44	133	116	124	145	
14	Benzoyl bromide	218-9			1.570 <sup>15</sup>		122	130	163	158		

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

III. Acyl Bromides a) Liquids

2) (Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amides)\*

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	p-Toluidide	2-Naphthyl amide	Miscellaneous
						B p, °C	M p, °C					
1	3-Methylbenzoyl bromide	137 <sup>52</sup>					111	94-97	126	118		
2	n-Pentanoyl bromide (n-Valeryl bromide)	64 <sup>66</sup>				186-5		106	63	74		
3	3-Chlorobenzoyl bromide	145 <sup>40</sup>					158, 155	134	122			
4	2-Chlorobenzoyl bromide	144 <sup>37</sup>					140	142	114, 118	131		
5	2-Methylbenzoyl bromide	135 <sup>37</sup>					104-5	143	125	144		
6	2-Bromobenzoyl bromide	167 <sup>18</sup>					150	155	141			
7	Phenylacetyl bromide	150-5 <sup>30</sup>					76	156	117-8	135-6	159	
8	4-Methylbenzoyl bromide	147 <sup>42</sup>					179-80	160	145-148	160, 165		
9	4-Methoxybenzoyl bromide	185 <sup>27</sup>					184-6	167, 163	169-71	186		
10	4-Chlorobenzoyl bromide	142 <sup>27</sup>					240	179, 170	194			
11	4-Bromobenzoyl bromide	136 <sup>18</sup>					251	189	197			
12	Succinyl dibromide	105-6 <sup>13</sup>					186	260 (di)	230 (di)	255 (di)		

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES**

**III. Acyl Bromides b) Solids (Listed in order of increasing m.p.)\***

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Amide	p-Toluidide	2-Naphthyl amide	Miscellaneous
						B p, °C	M p, °C					
1	<b>3-Nitrobenzoyl bromide</b>		43				140	143	154	162		
2	<i>trans</i> -Cinnamoyl bromide		48				133	148	151, 153	168		
3	<b>4-Iodobenzoyl bromide</b>		55				270, 265	217	210			
4	<b>3,5-Dinitrobenzoyl bromide</b>		60				204-5	183	234			
5	<b>4-Nitrobenzoyl bromide</b>		64				241	201, 198	211	203		
6	<b>Phthaloyl dibromide</b>		80				206	220 ( <i>di</i> )	253 ( <i>di</i> )	201 ( <i>di</i> )		

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES**  
**IV. Acyl Iodides. Liquids 1) (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	<i>p</i> -Toluidide	2-Naphthyl amide	Miscellaneous
						B p, °C	M p, °C					
1	Acetyl iodide	108			1.98 <sup>17</sup>	118		82	114	147	134	
2	Propionyl iodide	127				141		81	106 103	126		
3	<i>n</i> -Butyryl iodide	146-8				162.5		115	96	75	125	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES**

**IV. Acyl Iodides. Liquids**

**2) (Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amides)\***

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Amide	p-Toluidide	2-Naphthyl amide	Miscellaneous
						B p, °C	M p, °C					
1	Dichloroacetyl iodide	55 <sup>15</sup>		1.5754		194		98	118	153		
2	Chloroacetyl iodide	37 <sup>4</sup>		1.5903			63	120	137, 134	162	117-8	
3	Benzoyl iodide	109 <sup>10</sup>					122	130	163	158		
4	Trichloroacetyl iodide	74 <sup>30</sup>		1.5711		197	57-8	141	97-94	113		

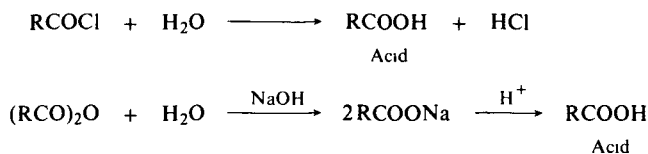
\*Derivative data given in order m p, crystal color, solvent from which crystallized



## EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV

The derivatives of three classes of compounds (carboxylic acids, acyl halides and acid anhydrides) are essentially the same as those of carboxylic acids, and are prepared either directly from the acid or *via* the acyl halide. All of them appear therefore under the same title.

*Hydrolysis of acid halide or acid anhydride to the corresponding carboxylic acid*



From the acyl halide in water

*For directions and examples see* Wild, p 180

From the acyl halide with aqueous sodium hydroxide

*See* Vogel, p 369, Wild, p 180

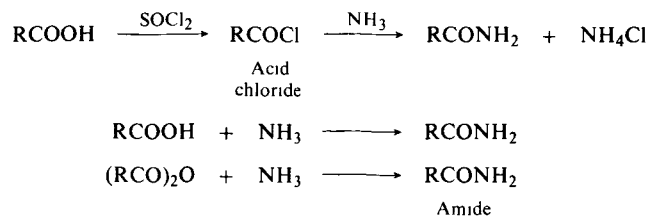
From the acid anhydride with water

*See* Vogel, p 376, Wild, p 184, A C D Rivett and N V Sidgwick, *J Chem Soc*, **97**, 1677 (1910)

From the acid anhydride with aqueous sodium hydroxide

*See* Linstead, pp 16-7 Wild, p 184

*Amide \**



Acid chloride is prepared from the acid and thionyl chloride. Amide is formed on addition of aqueous ammonia.

*For directions and examples see* Cheronis, p 440, Shriner, p 200, Vogel, p 361, Wild, p 181

From the acid chloride in benzene with aqueous ammonia

*See* D Swern, J M Stutzman and E T Roe, *J Amer Chem Soc*, **71**, 3017 (1942)

By passing gaseous ammonia through a benzene or ether solution of the acyl chloride

*See* Linstead, p 14, Wild, p 182

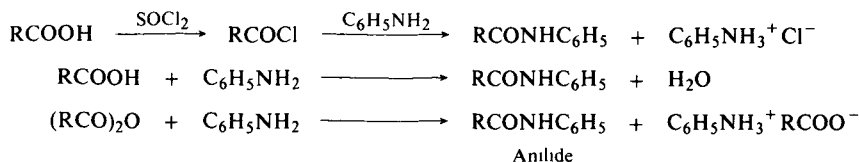
From the neat acid with gaseous ammonia

*See* J A Mitchell and E E Reid, *J Amer Chem Soc*, **53**, 1879 (1931)

From the acid anhydride with aqueous ammonia

*See* Wild, p 184, 185

*Anilide \**



From the acid chloride (prepared from the acid and thionyl chloride) and aniline in benzene or in ether

*For directions and examples see* Cheronis, p 445, Linstead, p 14, Shriner, pp 98, 200-1, Vogel, pp 361, 369, 458, Wild, p 182, P W Robertson, *J Chem Soc*, **115**, 1210 (1919)

From the acid chloride with aniline in aqueous sodium hydroxide

*See* Wild, pp 181, 219

From the acid and aniline at high temperatures

*See* Vogel, p 362

\*Derivatives recommended for first trial

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives.

EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV (Continued)

From the sodium salt of the acid with aniline and concentrated hydrochloric acid

See Shriner, p 201, Wild, p 154

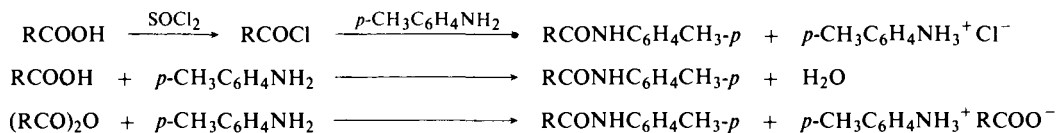
From the acid anhydride with aniline without solvent

See Linstead, p 17, Vogel, p 377, Wild, p 185

From the acid anhydride with aniline in benzene

See Linstead, p 15, Wild, p 185

*p*-Toluidide \*



From the acid chloride with *p*-toluidine in ether or benzene

For directions and examples see Cheronis, pp 441, 444, 458, Linstead, p 14, Shriner, pp 200-1, Vogel, p 361

From the acid and *p*-toluidine at high temperatures

See Cheronis, pp 441, 442-3, Vogel, p 362

From the sodium salt of the acid, *p*-toluidine and concentrated hydrochloric acid

See Shriner, p 201, Wild, p 154

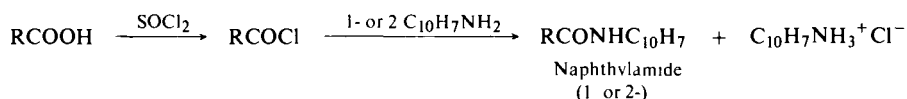
From the acid anhydride with *p*-toluidine without solvent

See Cheronis, p 459, Linstead, p 17

From the acid anhydride with *p*-toluidine in benzene

See Wild, p 185

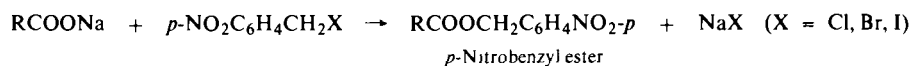
1- and 2-Naphthylamide \*



From the acid chloride with the naphthylamine

For directions and examples see Cheronis, p 446, P W Robertson, *J Chem Soc*, 115, 1210 (1919)

*p*-Nitrobenzyl ester \*



From an aqueous solution of the sodium salt of the acid, with the *p*-nitrobenzyl halide in ethanol

For directions and examples see Cheronis, pp 447, 448, Shriner, p 200, Vogel, p 362, Wild, pp 144-5

From an aqueous solution of the sodium salt of the acid with *p*-nitrobenzyl bromide in acetone

See F F Blicke and F D Smith, *J Amer Chem Soc*, 51, 1947 (1929)

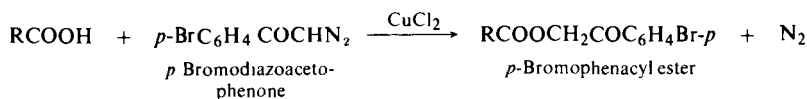
From the sodium or the potassium salt of the acid and *p*-nitrobenzyl bromide in 1:2 water-ethanol

See E E Reid, *J Amer Chem Soc*, 39, 124 (1917)

From the sodium or the potassium salt of the acid and *p*-nitrobenzyl chloride or iodide in 1:2 water-ethanol

See J A Lyman and E E Reid, *J Amer Chem Soc*, 39, 701 (1917)

*p*-Bromophenacyl ester \*



From the sodium salt of the acid and *p*-bromophenacyl bromide in aqueous ethanol

\*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives



## EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV (Continued)

From the acid chloride and ethanol.

See: Vogel, p. 389.

NOTE: The same methods can be used for the formation of other esters.

### S-Benzylthiuronium salt.\*



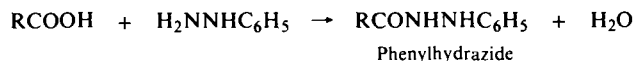
From the sodium or the potassium salt of the acid and S-benzylthiuronium chloride in water.

For directions and examples see: Linstead, p. 15; Vogel, p. 36; Wild, p. 149; S. Veibel and H. Lillelund, *Bull. Soc. Chim.* [5], 5, 1153 (1938), S. Veibel and K. Ottung, *Bull. Soc. Chim.* 6, 1434 (1939).

From the sodium or the potassium salt of the acid in water or in aqueous ethanol with an ethanolic solution of S-benzylthiuronium chloride.

See: Cheronis, p. 449; Shriner, p. 202; J. J. Donleavy, *J. Amer. Chem. Soc.*, 58, 1004 (1936).

### Phenylhydrazide.



From the acid with phenylhydrazine without solvent.

For directions and examples see: Shriner, p. 201; Wild, p. 152; G. H. Stempel and G. S. Schaffel, *J. Amer. Chem. Soc.*, 64, 470 (1942).

From the acid with phenylhydrazine in benzene.

See: Shriner, p. 201; Wild, p. 152.

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES

a) 'Liquids 1) (Listed in order of increasing atmospheric b.p.)\*

No	Acid anhydride	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	p-Toluidide	2-Naphthylamide	Miscellaneous
						B P	M P					
1	Trifluoroacetic	39		1.269 <sup>25</sup>	1.490 <sup>25</sup> <sub>4</sub>	72		75	88			
2	Perfluoropropionic	72		1.273 <sup>25</sup>	1.571 <sup>25</sup> <sub>4</sub>	96		95				
3	Perfluoro-n-butyric	108		1.285 <sup>20</sup>	1.665 <sup>20</sup>	120		105	93			
4	Acetic	140	-73	1.3904 <sup>20</sup>	1.0811 <sup>20</sup>	118	16	82	114	153		
5	n-Propionic	167	-45	1.404 <sup>20</sup>	1.017 <sup>15</sup>	141		81	106	126 (124)		
6	Perfluoro-n-caproic (Perfluoro-n-hexanoic)	176		1.295 <sup>20</sup>	1.769 <sup>25</sup> <sub>4</sub>	157		117				
7	Isobutyric	182			0.957 <sup>17</sup>	154		128	105	107		
8	Pivalic (Trimethylacetic)	190				164	35	154	129	120		
9	n-Butyric	198			0.978 <sup>15</sup>	162		115	96	75 (73)	125	
10	Citraconic (Methylmaleic)	214	7-8	1.471 <sup>21.5</sup>	1.238 <sup>25</sup> <sub>4</sub>		92d	185-7 (di)	175 (di)			
11	Isovaleric	215				176		135 (137)		107	138	
12	Dichloroacetic	216d				194		98	118	153		
13	Valeric (Pentanoic)	218			0.922 <sup>17</sup>	186		106	63	74	112	
14	Crotonic	248		1.4745 <sup>20</sup>	1.0397 <sup>20</sup>	189	72	161 (158)	118 (115)	132		
15	Caproic (n-Hexanoic)	254-7 (245)		1.4297 <sup>20</sup>	0.92 <sup>20</sup>	205		100	95 (92)	75 (73)	107	
16	n-Heptanoic	258		1.4335 <sup>15</sup>	0.9175 <sup>20</sup>	223		96	70 (65)	81	101	
17	α-Methylglutaric	272-5					79		175 6 (di) mono (2 forms) 114 or 100	174 5 (di) mono (2 forms) 126 or 98-9	227-8 (di), 115-9 (mono)	
18	Caprylic (n-Octanoic)	280-5		1.436 <sup>17</sup>	0.9065 <sup>17</sup>	239	16	110 (106)	57 (55)	70	103	
19	cis-Hexahydroisophthalic	304	-1				187 9		298-9 (di)			

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES**

**a) Liquids 2) (Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amide derivative)\***

No.	Acid anhydride	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	p-Toluidide	2-Naphthylamide	Miscellaneous
						B.P.	M.P.					
1	DL- $\alpha$ -Bromobutyric.....	148-52 <sup>10</sup>	.....	.....	.....	127 <sup>25</sup>	-4	112	.....	.....	.....	4-Nitrophenyl ester, 48-9; 2-Naphthyl ester, 54
2	DL- $\alpha$ -Bromopropionic.....	120 <sup>5</sup> (123-4 <sup>10</sup> )	.....	.....	.....	204	26	123	.....	.....	.....	.....

\* Derivative data given in order: m.p., crystal color, solvent from which crystallized.

TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES

b) Solids (Listed in order of increasing m.p.)\*

No	Acid anhydride	Melting point, °C	Boiling point, °C	Acid		Amide	Anilide	p-Toluidide	2 Naphthylamide	Miscellaneous
				B P	M P					
1	Oleic	22			16	76	41	43	169	
2	Capric (n-Decanoic)	24		268 70	31	108, 98	70	78	104	D <sub>B</sub> <sup>0</sup> 0 8596, n <sub>D</sub> <sup>20</sup> 1 4234
3	β-Ethyl-β-methylglutaric	25	185 <sup>20</sup>		87		105 (mono)			1-Naphthylamide, 126
4	Hexahydrobenzoic	25	280-3	232	29-30	185-6				
5	α,α-Dimethylsuccinic (unsym - Dimethylsuccinic)	29	220		141					α-Me ester, 41 β Me ester, 52, Anil, 87
6	cis-Hexahydrophthalic	32	145 <sup>18</sup>		192					Conc HCl at 180 → trans form, 221
7	DL-Methylsuccinic	37	244-8		115 (112)	225 (di)	123, chl (mono), 159 et, ac, (mono)	164 (mono)	155 (mono)	Anil, 109-10
8	n-Undecanoic (n-Hendecanoic)	37		284	30	103, 99	71	80		
9	2-Methylbenzoic (o-Toluic)	39			104 5	143	125	144		
10	β-Methylglutaric	41	276-8		87		200 (di) 121 (117) (mono)	mono 135	143 (mono)	
11	Bromoacetic	41-2		208	50	91	131			134
12	Lauric (n-Dodecanoic)	42		299	44 (42)	110, 100	78	87		106
13	Benzoic	42	360		122	130	163	158		
14	trans-α,β-Dimethylsuccinic	43			198 (208)	238 (di) 165 7 (mono)				Imide, 78
15	Iodoacetic	46			83	95	143 4			
16	Chloroacetic	46		189	63	121	134	162		117-8
17	n-Tridecanoic	50		312	44	100	80	88		
18	DL-Phenylsuccinic	54	204-6 <sup>22</sup>		168	209 10 (di) 158-9 (α) 144 5 (β-)	222 (di) 175 (α-) 170-1 (β-)	175 (α-) 168 9 (β-)		Imide, 90
19	Myristic (n-Tetradecanoic)	54		202 <sup>16</sup>	54	107,103	84	93	108	D <sub>4</sub> <sup>0</sup> 0 8502, n <sub>D</sub> <sup>20</sup> 1 4335
20	Glutaric	56		200 <sup>20</sup>	97	di 175 6	224	218		
21	Maleic	56, 52-4	198		130	181 (172) (mono) 266 (di)	173-5 (mono) 187 (di)	di 142		
22	Suberic (dimer) (Octanedioic)	56-7			144 (141)	127 (mono) 217 (di)	128 (mono) 186 (di)	di 218		
23	α-Bromoisobutyric	63-5		198-200	48-9	148	83	92	135	1-Naphthylamide, 116
24	Palmitic (n-Hexadecanoic)	64		222 <sup>16</sup>	63	106 7	90	98	109	D <sub>4</sub> <sup>0</sup> 0 847, n <sub>D</sub> <sup>20</sup> 1 4357
25	Margaric (n-Heptadecanoic)	67		231 <sup>16</sup>	61	108				
26	Itaconic (Methylenesuccinic)	67-8			165	di 192	190, 185			
27	Sebacic (dimer) (Decanedioic)	68		243 <sup>15</sup>	133	210 (di) 170 (mono)	201 (di), 122 (mono)	201		
28	Stearic (n-Octadecanoic)	70			70	109	95	102	112	
29	3-Methylbenzoic (m-Toluic)	71			111 3	94	126	118		Hydrazide, 97
30	Phenylacetic	72			76-7	156	118	136	159	
31	2-Bromobenzoic	75-6			150	155 6				Hydrazide, 153
32	Arachidic (n-Eicosanoic)	77-8			77	108-9	92	96	112	
33	2-Chlorobenzoic	79			142, 140	142	114, 118	131		
34	cis-α-Methylglutaconic	85			118		148 (mono)			
35	cis-β-Methylglutaconic	86			147-9		143 (mono)			Mono-Et ester, 73
36	cis-α,β-Dimethylsuccinic	87			129,122	148 9 (mono) 244 (di)	222 (di)			Imide, 111, 101, Anil, 146
37	3,5-Dichlorophthalic	89			164					Imide, 208, N-Phenyl-imide, 150
38	4-Methylphthalic	92	295		152	188 (di)				Imide, 196
39	3-Chlorobenzoic	95			158, 155	134	122			
40	4-Methylbenzoic (p-Toluic)	95			179 80	160	145	160		
41	Diphenylacetic	98			148	167-8	180			Me ester, 60

\* Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Acid anhydride	Melting point, °C	Boiling point, °C	Acid		Amide	Anhydride	p-Toluidide	2-Naphthylamide	Miscellaneous
				B P	M P					
42	4-Chlorophthalic	99			157					Imide, 210-11, Di-Me ester, 37, Anil, 174
43	Anisic (4-Methoxybenzoic)	99			184-6	167, 163	169 71	186		
44	DL-Benzylsuccinic	102			161					Imide, 97 8, Dihydrazide, 146
45	β-Phenylglutaric	105			140		171 (168) (mono)	154 (mono)		Imide, 174, Di-Me ester, 86-7
46	4-Ethoxybenzoic	108			198	202	170			Hydrazide, 124
47	α-Benzylcinnamic	108-9			158					Me ester, b p 278, Et ester, 38-9
48	3,5-Dinitrobenzoic	109			204-5	183	234			
49	4-Bromophthalic	113			173-5, 109					Di-Me ester, 40
50	3-Methylphthalic	114-5, 110			157					Imide, 189-90
51	4-Nitrophthalic	119			165	200d	192	mono 172		
52	Succinic	120	261		186	157 (mono), 260 (di)	148 (mono), 230 (di)	180 (mono), 255 (di)		
53	Nicotinic (3-Pyridine-carboxylic)	123			237 8	128	85	150		
54	3-Chlorophthalic	124 5			186					Imide, 118 20 (sealed tube)
55	4-Iodophthalic	125-6			182, 185					Imide, 224-4
56	3,4-Dimethylphthalic	126			201					Imide, 240-1, Methylimide, 98 9
57	3-Bromophthalic	132-4			188, 178					Mono-Et ester, 127 8
58	Phthalic	132			206, 200	149 (mono), 220 (di)	170 (mono), 253-5 (di)	mono 160		
59	3-Iodobenzoic	134			187	187				Me ester, 54-5
60	2-Naphthoic (β-Naphthoic)	135			184	192-3	171-2	192		
61	2-Nitrobenzoic	135			146	176	155			
62	Cinnamic	136			133	148	151, 153	168		
63	trans-DL-Hexahydrophthalic acid	140			221	mono 196				Mono-Me ester, 96, Di-Me ester, 33
64	Homophthalic (2-Carboxy-phenylacetic)	141			180-1	230 (2-), 185 (α-)	231			α-Me ester 96 8 2-Me ester, 143 5, α-Et ester, 107 8, Imide, 233
65	1-Naphthoic (α-Naphthoic)	146			162	202	163			Piperidide, 85-7
66	3-Bromobenzoic	148-9			155	155				Hydrazide, 151
67	3-Iodophthalic	159 61			206					Di-Me, ester, 89, Di-Et ester, 70, Imide, 238
68	2,4-Dinitrobenzoic	160			183	203				
69	3-Nitrobenzoic	160, 163			140	143	154	162		
70	3-Nitrophthalic	162			218	201 (di)	234 (di)	226 (di)		
71	3,5-Dinitrophthalic	163-4, 161			226					Et ester, 187, Di-Et ester, 73
72	4,5-Dichlorophthalic	188	313		200, 188					Mono-Et ester, 133 4
73	4-Nitrobenzoic	189			241	201, 198	211, 204	204, 192		
74	4-Chlorobenzoic	194			240	179, 170	194			
75	3,6-Dichlorophthalic	194-5	339		194-5					Mono-Et ester, 130 1
76	3,4-Di-iodophthalic	198			212-3					Di-Et ester, 60, Imide, 242, Anil, 191
77	β-Phenylglutaconic	206			154-5	138 (mono)	174 (mono)	184 (mono)		Anil, 270
78	4,5-Dimethylphthalic	208			123, 196					Mono-Et ester, 78, Imide, 256-7
										Methylimide, 150, Ethylimide, 89

\*Derivative data given in order m p, crystal color, solvent from which crystallized



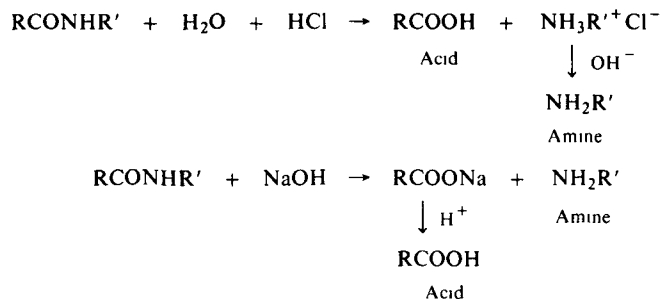
TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Acid anhydride	Melting point, °C	Boiling point, °C	Acid		Amide	Anilide	p-Toluidide	2-Naphthylamide	Miscellaneous
				B P	M P					
79	2,2'-Diphenic	217			229	191 (mono) 212 (di)	176 (mono) 230 (di)			H <sub>2</sub> SO <sub>4</sub> at 100-120 → Fluorenone-4-carboxylic acid, 227
80	4-Bromobenzoic	218			251	189	197			
81	D-Camphoric	221			188	177 (mono) 193 (di)	209 (204) (mono), 226 (di)	α 212-4, β 190-6		
82	4-Iodobenzoic	228			270, 267	217 8				Me ester, 114
83	Tetrachlorophthalic	256, 249			250 d					Mono-Me ester, 142, Mono-Et ester, 94 5, Imide, 338-9, 2-Naphthylimide, 287, Anil, 268-9
84	1,8-Naphthalenedicarboxylic	274			274		250 82 (di)			Heat with aq NH <sub>3</sub> → 1,8-Naphthalimide, 300 N-Phenylimide, 202 Di-Me ester, 102 3
85	Tetrabromophthalic	280			266					Mono-Me ester, 267, Imide, > 380, yel, Anil, 279-80, p-Tolil, 280, 2-Naphthylimide, 306-8
86	Tetraiodophthalic	318, 325, yel			324 7					Mono-Me ester, 298

\* Derivative data given in order m p, crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE XV

*Hydrolysis of amide or imide to the corresponding carboxylic acid and amine \**



From the amide with aqueous hydrochloric acid

*For directions and examples see* Cheronis, pp 607, 608, Vogel, pp 404, 808

From the amide with 85% or 100% phosphoric acid

*See* Cheronis, p 609, G Berger and S C J Olivier, *Rec Trav chim*, **46**, 600 (1927), W M Dehn and K E Jackson, *J Amer Chem Soc*, **55**, 4284 (1933)

From the amide with 70% sulfuric acid

*See* Wild, p 193

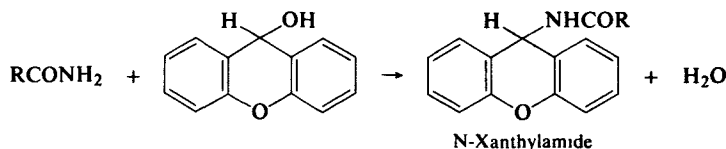
From the amide with aqueous sodium hydroxide

*See* Cheronis, p 609, Vogel, pp 404, 799, Wild, p 193

*NOTE* For directions and examples for preparation of derivatives of carboxylic acids formed on hydrolysis of amides and imides see explanations and references to Tables XII, XIII and XIV, p 186, 187, 188, 189

For directions and examples for preparation of derivatives of amines formed on hydrolysis of amides and imides see explanations and references to Table XVIII, p 291, 292, 293, 294

*N-Xanthylamides \**



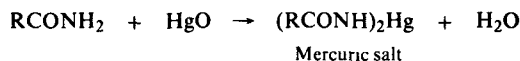
From the amide with xanthhydrol in glacial acetic acid

*For directions and examples see* Cheronis, p 610, Linstead, p 66, Shriner, p 222, Vogel, p 405, Wild, p 195, R F Phillips and B M Pitt, *J Amer Chem Soc*, **65**, 1355 (1943), W Andriani, *Rec Trav chim*, **35**, 180 (1916)

From the amide with xanthhydrol in ethanol-water-acetic acid mixture

*See* Shriner, p 222, Wild, p 195, R F Phillips and B M Pitt, *J Amer Chem Soc*, **65**, 1355 (1943)

*Hg salt (Hg derivative) \**



From the amide with mercuric oxide in methanol or ethanol

*For directions and examples see* Cheronis, pp 610, 611, Wild, p 197, J W Williams, W T Rainey and R S Leopold, *J Amer Chem Soc*, **64**, 1738 (1942)

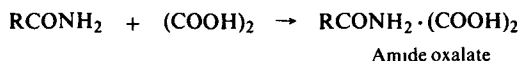
From the amide with mercuric oxide in water

*See* Vogel, p 405

From the amide with yellow mercuric oxide without solvent

*See* Cheronis, p 611, Wild, p 196, J W Williams, W T Rainey and R S Leopold, *J Amer Chem Soc*, **64**, 1738 (1942)

*Oxalate*



From the amide with anhydrous oxalic acid in the presence of ethyl acetate

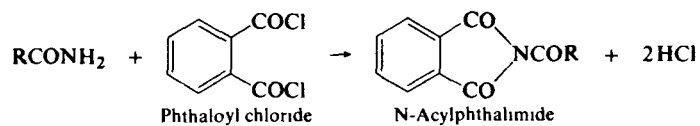
\*Derivatives recommended for first trial

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLE XV (Continued)

For directions and examples see: Cheronis, p. 611; Wild, p. 196; C. A. MacKenzie and W. T. Rawles, *Ind. Eng. Chem., Anal. Ed.*, **12**, 737 (1940).

*N*-Acylphthalimide (Phthalimide derivative).



From the amide with phthaloyl chloride in toluene or without solvent.

For directions and examples see: Cheronis, p. 611; T. W. Evans and W. M. Dehn, *J. Amer. Chem. Soc.*, **51**, 3651 (1929).

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

a) Liquids (Listed in order of increasing b.p.)\*

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Derived acid				Derived amine				Miscellaneous
						M P, °C	B P, °C	<i>p</i> -Nitro benzyl ester	<i>p</i> -Bromo-phenacyl ester	M P, °C	B P, °C	Acet-amide	Benz-amide	
1	N,N-Dimethylformamide	153, 76 <sup>49</sup>	-61	1.42938 <sup>22,4</sup>	0.9484 <sup>22,4</sup>	8.4	100.7	31	140, 135		7		41	Xanthy deriv., 184, Oxalate, 107.4.7.7
2	N,N-Diethylformamide	176-8, 68 <sup>15</sup>			0.908 <sup>16</sup>	8.4	100.7	31	140, 135			56	42	
3	N-Methylformamide	180-5, 131 <sup>90</sup>	-3.8, -5.4	1.4310 <sup>45</sup>	1.011 <sup>19</sup>	8.4	100.7	31	140, 135		-6	28	80	
4	Formamide	193, 195d	2.55			8.4	100.7	31	140, 135		NH <sub>3</sub>			
5	N-Ethylformamide	197.9			0.952 <sup>21</sup>	8.4	100.7	31	140, 135		16.5, 19		71	
6	N-Formylpiperidine (Form-N-piperidine)	222				8.4	100.7	31	140, 135		106		48	
7	N-Acetylpiperidine (Aceto-N-piperidine)	226				166	118.2	78	86.0		106		48	
8	N-Methylformanilide	243-4, 249-51, 128-9 <sup>15</sup>	12.5		1.0928 <sup>23</sup>	8.4	100.7	31	140, 135		196	102	63	
9	N-Ethylformanilide	258 <sup>728</sup> , 123 <sup>11</sup>			1.0549	8.4	100.7	31	140, 135		205	54	60	
10	N-Propylformanilide (cor.)	267 <sup>731</sup>			1.044 <sup>16</sup>	8.4	100.7	31	140, 135		222	47		
11	N-Isobutylformanilide (cor.)	274 <sup>731</sup>				8.4	100.7	31	140, 135		227			
12	N-Isoamylformanilide	285-6 <sup>728</sup>			1.004 <sup>16</sup>	8.4	100.7	31	140, 135		254.5 (cor.)			

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point °C	Xan thyl amide	Derived acid				Derived amine				Miscellaneous
				M P °C	B P °C	<i>p</i> Nitro benzyl ester	<i>p</i> Bromo phenacyl ester	M P, °C	B P °C	Acet amide	Benz amide	
1	<i>n</i> -Butyranilide	35		-5 5 -8	162 5 164		63		184	114	160	
2	Oleanilide	41		$\alpha$ 13 36 $\beta$ 16 25	250 (super heated steam) 216 <sup>s</sup>		40 46		184	114	160	
3	<i>N</i> -Benzpiperidide ( <i>N</i> -Benzoyl piperidine)	48		122 4	249	89	119 0		106		48	
4	Ethyl urethane (Ethyl carbamate)	49 48	169						NH <sub>3</sub>			
5	Formanilide	50 47		8 4	100 7	31	140 135		184	114	160	B p 271 Benzyl chloride → benzyl form anilide 48
6	Malonic acid monoamide (Malonamic acid)	50		134 8 9		<i>di</i> 85 5			NH <sub>3</sub>			
7	<i>N</i> -Propylacetanilide	50		16 6	118 2	78	86 0			47		
8	Difluoroacetamide	52			134 5				NH <sub>3</sub>			
9	<i>N</i> -Benzyl- <i>n</i> -caproamide	53		-3 9	203 35		72		184 5	60	105	
10	Phenyl urethane (Phenyl carbamate)	53							184	114	160	
11	Methyl urethane (Methyl carbamate)	54 52	193						NH <sub>3</sub>			
12	<i>N</i> -Ethylacetanilide	54		16 6	118 2	78	86 0		205	54	60	B p 249
13	<i>n</i> Butyl urethane ( <i>n</i> Butyl carbamate)	54							NH <sub>3</sub>			
14	<i>N</i> -Benzylisovaleramide	54		-30	176 5	68 0	135 137		184 5	60	105	
15	Acetoacetamide	54							NH <sub>3</sub>			
16	Isobutyl urethane (Isobutyl carbamate)	55	148						NH <sub>3</sub>			
17	<i>N</i> -Methyl-2-acetotoluidide	56		16 6	118 2	78	86 0		208	56	66	
18	Carprylanilide	57 55		16 3	237 239 3		67 4		184	114	160	
19	Pelargonanilide	57		12 3	254 4		68 5		184	114	160	
20	<i>N</i> -Benzylacetanilide	58		16 6	118 2	78	86 0	37	298	58	107	
21	Methoxyacetanilide	58			204 203				184	114	160	
22	<i>d</i> -Lactanilide	59		18	122 <sup>15</sup>		112 8		184	114	160	
23	<i>N</i> -Ethylbenzanilide	60		122 4	249	89	119 0		205	54	60	
24	<i>n</i> -Propyl urethane ( <i>n</i> Propyl carbamate)	60							NH <sub>3</sub>			
25	<i>N</i> -Benzylformamide	60		8 4	100 7	31	140 135		184 5	60	105	
26	<i>N</i> -Benzylacetamide	61		16 6	118 2	78	86 0		184 5	60	105	
27	Propiolamide	61-2		18	144 <sup>d</sup>				NH <sub>3</sub>			
28	<i>n</i> -Valeranilide ( <i>n</i> -Pentanilide)	63		-34 5	186 4		75		184	114	160	
29	Isoamyl urethane (Isoamyl carbamate)	64	145						NH <sub>3</sub>			
30	Erucanilide	65, 55		33 4	264 <sup>15</sup>		62 5		184	114	160	
31	3-Acetotoluidide ( <i>N</i> Acetyl- <i>m</i> toluidine)	66 65		16 6	118 2	78	86 0		203	65	125	
32	<i>N</i> -Methyl-3-acetotoluidide	66		16 6	118 2	78	86 0		206 7	66	125	
33	Ethyl oxanilate .....	66 7							184	114	160	
34	Benzindole	68		122 4	249	89	119	52	253	157 8	68	
35	Heptananilide	70, 65		-7 46	223		72		184	114	160	
36	Capranilide ( <i>n</i> -Decananilide)	70		31 3	268 7		60		184	114	160	
37	<i>n</i> -Undecananilide ( <i>n</i> Hendecananilide)	71		28 5 $\alpha$ 13 4 $\beta$ 16 3	280, 284		68 2		184	114	160	

\*Derivative data given in order m p , crystal color solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No.	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous	
				M.P., °C	B.P., °C	<i>p</i> -Nitrobenzyl ester	<i>p</i> -Bromophenacyl ester	M.P., °C	B.P., °C	Acetamide	Benzamide		
38	2-Methylhexanamide	72			209.6				NH <sub>3</sub>				
39	<i>N,N</i> -Diphenylformamide	73		8.4	100.7	31	140; 135	53-4		101	180		
40	Vinylacetanilide	73		-35	169; 163				184	114	160		
41	Oleamide	76		$\alpha$ : 13.36 $\beta$ : 16.25	250 (superheated steam); 216 <sup>5</sup>		40-6		NH <sub>3</sub>				
42	Thioacetanilide	76			93				184	114	150		
43	Tiglamide	76		64.5-5.0	198.5 (cor.)	64	68		NH <sub>3</sub>				
44	Tiglanilide	77		64.5-5.0	198.5 (cor.)	64	68		184	114	160		
45	4-Methylhexananilide	77			217-8 <sup>254</sup>				184	114	160		
46	Lauranilide (Dodecananilide)	78		44; 42	299		76		184	114	160		
47	<i>d,l</i> -2,3-Dimethylbutananilide	78		-1.5	191.7				184	114	160		
48	Pentadecananilide	78		52.3	212 <sup>16</sup>	39.5-40 (cor.)	77.2		184	114	160		
49	<i>d,l</i> -Lactamide	78.5-9.0; 76		18	122 <sup>15</sup>		112.8		NH <sub>3</sub>				
50	Transbrassidanilide	79		59.7	256 <sup>10</sup>		94.2		184	114	160		
51	2-Acetophenetidide ( <i>N</i> -Acetyl- <i>o</i> -phenetidine)	79		16.6	118.2	78	86.0		229	79	104		
52	<i>d,l</i> -2-Methylpentanamide	79.6; 80			195-6				NH <sub>3</sub>				
53	Tridecananilide	80		43; 41.6	312; 177 <sup>10</sup>		75.0		184	114	160		
54	<i>d,l</i> - $\alpha$ -Chloropropionamide	80			186				NH <sub>3</sub>				
55	Propionamide	81; 77	214; 211	-20.8	141	31	63.4		NH <sub>3</sub>				Mercury deriv., 201; Oxalate, 80.8-1.0
56	Acetamide	82	245; 238-40	16.6	118.2	78	86.0		NH <sub>3</sub>				Mercury deriv., 196-7; Oxalate: 127.3; Phthalimide, 135-6
57	Ethoxyacetamide	82			206-7		104.8		NH <sub>3</sub>				
58	<i>N</i> -Methyl-4-acetotoluidide	83		16.6	118.2	78	86.0		210	83			
59	$\alpha$ -Bromoisobutyranilide	83		48-9	198-200				184	114	160		
60	$\gamma$ -Phenylbutyramide	84		52	290				NH <sub>3</sub>				
61	Myristanilide	84		53.9	212 <sup>16</sup>		81		184	114	160		
62	Acrylamide	85		13	141; 140				NH <sub>3</sub>				
63	Allylurea	85							58				
64	Acetoacetanilide	85							184	114	160		
65	<i>d,l</i> - $\alpha$ -Ethylphenylacetamide ( $\alpha$ -Phenylbutyramide)	86; 83		42	270				NH <sub>3</sub>				
66	4- <i>n</i> -Propylacetanilide	87		16.6	118.2	78	86.0		225	87	115		
67	$\alpha$ -Undecylenamide ( $\alpha$ -Hendecylenamide)	87		24.5	275				NH <sub>3</sub>				
68	Propiolanilide	87		18	144d.				184	114	160		
69	3-Bromoacetanilide	87		16.6	118.2	78	86.0	18	251	87	120; 136		
70	<i>d,l</i> -3-Methylpentananilide	87		-41.6	197.5				184	114	160		
71	<i>n</i> -Butyl oxamate	88		189.5 (anh.); 101(+ 1H <sub>2</sub> O)		<i>di</i> : 204			NH <sub>3</sub>				
72	2-Chloroacetanilide	88		16.6	118.2	78	86.0		209; 207	87	99		
73	D-Chaulmoogranilide	89		68.5	247-8 <sup>20</sup>				184	114	160		
74	Palmitanilide	90		62.7	222 <sup>16</sup>	42.5	86; 82		184	114	160		
75	<i>N</i> -Phenylmaleimide	91		130		<i>di</i> : 91 (cor.)	168-70; 190		184	114	160		

\*Derivative data given in order: m.p., crystal color, solvent from which crystallized.

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous		
				M P °C	B P °C	p-Nitro-benzyl ester	p-Bromo-phenacyl ester	M P °C	B P °C	Acet amide	Benz amide			
76	Bromoacetamide	91		50	208	88				NH <sub>3</sub>				
77	α-Phenylpropionamide	92	158		265					NH <sub>3</sub>				
78	Isopropyl urethane (Isopropyl carbamate)	92								33				
79	Arachidamide	92		77 75	204 <sup>1</sup>		89			184	114	160		
80	d l α Chloropropionamide	92			186					184	114	160		
81	2,2-Dimethylbutanamide	92		-15 0	187 190					184	114	160		
82	2-Nitroacetamide	92 94		16 6	118 2	78	86 0	71			92 94	98 110		
83	Maleimide	93		130		di 91 (cor)	168 70 190			NH <sub>3</sub>				
84	Elaidamide	93 4		44 5 51	234 <sup>15</sup>		65			NH <sub>3</sub>				
85	Transbrassidamide	94		59 7	256 <sup>10</sup>		94 2			NH <sub>3</sub>				
86	2-Ethylpentanamide	94			209					184	114	160		
87	N-Methyl-N-(1-naphthyl) acetamide	94		16 6	118 2	78	86 0			294	94 5	121		
88	n-Caproamide (n Hexanamide)	95 92		-3 9	205 35		72			184	114	160		
89	N-Butyramide	95		-5 5 -8	162 5 164	35	63			184	114	160		
90	N-Benzylpalmitamide	95		62 7	222 <sup>10</sup>	42 5	86 82			184 5	60	105		
91	Azelaic acid monoamide	95		106 5	> 360 sl d 237 <sup>15</sup>	di 43 8	di 130 6			NH <sub>3</sub>				
92	d l-2-Methylpentanamide	95			195 6					184	114	160		
93	Iodoacetamide	95		83						NH <sub>3</sub>				
94	Stearamide	95		70 1 69 6			92			184	114	160		
95	Heptanamide	96	154 5	-7 46	223 0		72			NH <sub>3</sub>				
96	Trichlorolactamide	96		124						NH <sub>3</sub>				
97	Semcarbazide	96						14		113 5	mono 67 di (sym) 138	mono 172 5 di (sym) 241 (cor)		Gives semicarbazones with aldehydes and ketones
98	3-Toluamide	97, 94		111 3, 110 1	236, subl	86 6	108							Mercury deriv., 200
99	Trichloroacetamide	97, 94		57 8	197 5	80				184	114	160		
100	3-Acetophenetidine	97		16 6	118 2	78	86 0			248	37	103		
101	N-Benzylstearamide	97		70 1 69 6			92			184 5	60	105		
102	Glycolamide	97		78 9 80		106 8	138			184	114	160		
103	Methoxyacetamide	97			204 203					NH <sub>3</sub>				
104	Hydrocinnamide (β Phenylpropionamide)	98, 96		48 7, 40	279 80 (cor)	36 3	104			184	114	160		
105	α-Hydroxyisobutyramide	98		79	212	80 5	98			NH <sub>3</sub>				
106	Dichloroacetamide	98, subl		5-6	194		99			NH <sub>3</sub>				
107	2-Methylhexanamide	98			209 6					184	114	160		
108	4-Methylhexanamide	98			217 8 <sup>745</sup>					NH <sub>3</sub>				
109	4-Methyl-2-nitroacetamide	99, 94		16 6	118 2	78	86 0	117			99	148		
110	Capramide (n-Decanamide)	99	148	31 3	268 7		67 0			NH <sub>3</sub>				
111	2-Bromoacetamide	99		16 6	118	78	86 0	32		250	99	116		
112	Phenoxyacetamide	99		98 9, 99 100	285d		148 5			184	114	160		
113	Pelargonamide	99	147 5 8 5	12 3	254 4		68 5			NH <sub>3</sub>				
114	α-Bromopropionamide	99, 110		25 7	203 5					184	114	160		
115	n-Caproamide (n-Hexanamide)	100, 101	160	-3 9	203 35		72			NH <sub>3</sub>				Oxalate, 71 1-3
116	Tridecanamide	100		43, 41 6	312, 177 <sup>10</sup>		75			NH <sub>3</sub>				
117	Phenylpropiolamide	100, 109		136-7, subl		83				NH <sub>3</sub>				

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No.	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous
				M.P., °C	B.P., °C	<i>p</i> -Nitrobenzyl ester	<i>p</i> -Bromophenacyl ester	M.P., °C	B.P., °C	Acetamide	Benzamide	
118	N,N-Diphenylacetamide	101		16.6	118.2	78	86.0	53-4		101	180	
119	$\beta$ -Iodopropionamide	101		82; 85					NH <sub>3</sub>			
120	N,N'-Diacetyltrimethylenediamine	101		16.6	118.2	78	86.0		136	<i>mono</i> : 126; <i>di</i> : 101	<i>mono</i> : 140; <i>di</i> : 147	
121	Methylurea	101	230						-6	28	80	Picrate, 127d.
122	Phenoxyacetamide	101		98-9; 99-100	285d.		148.5		NH <sub>3</sub>			
123	N-Methylacetanilide	102		16.6	118.2	78	86.0		196	102	63	B.p. 237; Conc. HNO <sub>3</sub> + H <sub>2</sub> SO <sub>4</sub> → <i>p</i> -Nitro deriv., 153
124	Levulinanilide	102		33-5, deliq.	245-6	61	84		184	114	160	
125	Pentadecanamide	102		52.3	212 <sup>16</sup>	39.5-40 (cor.)	77.2		NH <sub>3</sub>			
126	Isocrotonamide	102		15	169		81		NH <sub>3</sub>			
127	Isocrotonanilide	102		15	169		81		184	114	160	
128	<i>n</i> -Undecanamide ( <i>n</i> -Hendecanamide)	103; 99		28.5; $\alpha$ :13.4; $\beta$ :16.3	280-4		68.2		NH <sub>3</sub>			
129	3-Benzophenetidine (N-Benzoyl- <i>m</i> -phenetidine)	103		122.4	249	89	119		248	97	103	
130	N,N-Dicyclohexylacetamide	103		16.6	118.2	78	86.0	20	225 sl. d.	103	153	
131	3,4-Dimethylbenzanilide	104		166; 164					184	114	160	
132	2-Benzophenetidine (N-Benzoyl- <i>o</i> -phenetidine)	104		122.4	249	89	119		229	79	104	
133	Pyruvanilide	104, subl.		13.6	165d; 80 <sup>25</sup>				184	114	160	
134	N-Cyclohexylacetamide	104		16.6	118.2	78	86.0		134	104	149	
135	2- <i>n</i> -Propylacetanilide	104-5		16.6	118.2	78	86.0		222-4	104-5	119	
136	2-Ethylpentanamide	105; 103			209				NH <sub>3</sub>			
137	Isobutyranilide	105		-46.1	154.7		76.8		184	114	160	
138	4- <i>n</i> -Butylacetanilide	105		16.6	118.2	78	86.0		261	105	126	
139	Acrylanilide	105		13	141; 140				184	114	160	
140	$\beta$ -Phenylpropionamide (Hydrocinnamamide)	105	189	48.7; 40	279-80 (cor.)	36.3	104		NH <sub>3</sub>			
141	Propionanilide	106; 103		-20.8	141	31	63.4		184	114	160	Conc. HNO <sub>3</sub> + H <sub>2</sub> SO <sub>4</sub> → <i>p</i> -Nitro deriv., 182
142	Palmitamide	106	142	62.7	222 <sup>16</sup>	42.5	86; 82		NH <sub>3</sub>			
143	N-Benzylbenzamide	106		122.4	249	89	119		184-5	60	105	
144	D-Chaulmoogramide	106		68.5	247-8 <sup>20</sup>				NH <sub>3</sub>			
145	<i>sym</i> -Dimethylurea	106							-6	28	80	
146	<i>n</i> -Valeramide ( <i>n</i> -Pentanamide)	106	167	-34.5	186.4		75		NH <sub>3</sub>			Oxalate, 61.1-4
147	Myristamide	107; 103		53.9	212 <sup>16</sup>		81		NH <sub>3</sub>			
148	N-Benzylbenzanilide	107		122.4	249	89	119	37	298	58	107	
149	Margaramide (Heptadecanamide)	108		61.2	231 <sup>16</sup>	48.5-9.0 (cor.)	82.6		NH <sub>3</sub>			
150	Thioacetamide	108		93					NH <sub>3</sub>			
151	Fluoroacetamide	108		31-2	167-9				NH <sub>3</sub>			
152	Levulinamide	108d.		33-5, deliq.	245-6	61	84		NH <sub>3</sub>			
153	Azelaic acid monoanilide	108		106.5	> 360 sl. d.; 237 <sup>15</sup>	<i>di</i> : 143.8	<i>di</i> : 130.6		184	114	160	
154	Arachidamide	108-9		77; 75	204 <sup>1</sup>		89		NH <sub>3</sub>			

\*Derivative data given in order: m.p., crystal color, solvent from which crystallized.



TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous
				M P, °C	B P, °C	p-Nitrobenzyl ester	p-Bromophenacyl ester	M P, °C	B P, °C	Acetamide	Benzamide	
155	Anthranilamide	109		147d				NH <sub>3</sub>				
156	2-Iodoacetanilide	109		16 6	118 2	78	86	61, 58		109	139	
157	Pimelic acid monoanilide	109		104-5, subl	223 <sup>15</sup>		di 136 6		184	114	160	
158	Stearamide	109	139 41	70 1, 69 6			92		NH <sub>3</sub>			
159	α-Methylhydrocinnamamide	109							NH <sub>3</sub>			
160	Lauramide (Dodecanamide)	170, 102		44, 42	299		76		NH <sub>3</sub>			
161	n-Caprylamide (n-Octanamide)	110, 108	148	16 3	237, 239 3		67 4		NH <sub>3</sub>			
162	Isovaleranilide	110		-30 0	176 5		68 0		184	114	160	
163	d,l-2-Methylbutananilide	110			176-7, 174		55		184	114	160	
164	3-Nitrophenylacetamide	110		120					NH <sub>3</sub>			
165	2-Ethylacetanilide	111		16 6	118 2	78	86 0		210-1	111	147	
166	β-Bromopropionamide	111		62 5					NH <sub>3</sub>			
167	3-Aminobenzamide	111		174d					NH <sub>3</sub>			
168	2-Ethylbutanamide	112, 107		-31 8	195				NH <sub>3</sub>			
169	4-Methylpentananilide (Isocaproanilide)	112, 110		-33	199 1 <sup>752</sup>		77 3		184	174	160	
170	d,l-2-Methylbutanamide	112			176-7, 174		55		NH <sub>3</sub>			
171	2-Acetotoluidide	112		16 6	118 2	78	86 0	200		110 1 <sup>1</sup>	146	KMnO <sub>4</sub> → Acetylanthranilic acid, 185
172	d-Hydno carpamide (α-Cyclopentylundecylamide)	112-3		60 5					NH <sub>3</sub>			
173	4-Aminobenzamide	114		118d					NH <sub>3</sub>			
174	Acetanilide	114 (cor)		16 6	118 2	78	86 0		184	114	160	B p 304, Conc HNO <sub>3</sub> + H <sub>2</sub> SO <sub>4</sub> → p-nitro deriv., 210
175	N-Benzylcrotonamide	114		72	189 (cor)	67 4	95-6		184-5	60	105	
176	Ethyl oxamate	114		189 5 (anh), 101(+ 2H <sub>2</sub> O) (rapid htng)		di 204			16 5, 19		71	
177	2-Chlorobenzanilide	114, 118		142, 140		106	106		184	114	160	
178	Dihydroacetic acid monoanilide	115		109	270				184	114	160	
179	n-Butyramide	115	185-7	-5 5, -8	162 5, 164		63		NH <sub>3</sub>			Mercury deriv., 222-4, Oxalate, 65 9 6 2
180	Methacrylamide	116		16	161				NH <sub>3</sub>			
181	α-Bromoisovaleranilide	116		44	230d				184	114	160	
182	trans-α-Crotonanilide	118, 115		72, w	189 (cor)	67 4	95-6		184	114	160	
183	Phenylacetanilide	118		76 5, subl	256 5 (cor)	65	89		184	114	160	Conc HNO <sub>3</sub> → 2,4-dinitrophenylacetic acid, 189
184	Dichloroacetanilide	118		5-6	194		99		184	114	160	
185	N-Ethyl-4-nitroacetanilide	118		16 6	118 2	78	86 0	96		119	98	
186	Trimesic acid trianilide	118-20d		380 (cor)			tri 197 (sealed tube)		184	114	160	
187	3-Iodoacetanilide	119		16 6	118 2	78	86 0	33, 27		119	157	
188	Cyanoacetamide	120	222-3	66					NH <sub>3</sub>			

\*Derivative data given in order m p crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m. p.)\* (Continued)

No	Name	Melting point °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous	
				M P °C	B P °C	p-Nitro benzyl ester	p-Bromo phenacyl ester	M P, °C	B P °C	Acet amide	Benz amide		
189	Glycolamide	120		78 9, 80		106 8	138		NH <sub>3</sub>				
190	Isocaproamide (Isohexanamide)	120 1	159-60	-33	199 1 <sup>75a</sup>		77 3		NH <sub>3</sub>				
191	Chloroacetamide	121	208 9	α 61 3 β 56 2, γ 52 5	189		104						
192	2-Chlorophenoxyacetamide	121		145 6, w						184	114	160	
193	Tribromoacetamide	122		131, 135	245d				NH <sub>3</sub>				
194	Sebacic acid monoanilide	122		33, subl	243 <sup>15</sup>	dt 73 5, 72 6	dt 147			184	114	160	
195	3-Chlorobenzanilide	122 5		158 155		107	116			184	114	160	
196	α-Bromopropionamide	125		25 7	203 5				NH <sub>3</sub>				
197	Furanilide	123 5		133 4 132	230-2	133 5	138 5			184	114	160	
198	Pyruvamide	124		13 6	165d 80 <sup>25</sup>				NH <sub>3</sub>				
199	3-Methylpentanamide	125		-41 6	197 5				NH <sub>3</sub>				
200	4-Chlorophenoxyacetamide	125		155 6 w 158			136			184	114	160	
201	3-Benzotoluidide (N Benzoyl m toluidine)	125		122 4	249	89	119 0			203	65	125	
202	2-Toluanilide	125		104-5, 107 8	259 <sup>7a1</sup>	90 7	57			184	114	160	
203	Acetyl-β-phenylhydrazine	125 6		16 6	118 2	78	86 0	19, 23	243	128, dt 107	168, dt 177		
204	Adipic acid monoamide	125-30		153 4 (cor)	216 <sup>15</sup>	106	154 5, 152 6		NH <sub>3</sub>				
205	Succinimide	126	245-7	185, 182 8	235d	dt 88	dt 211		NH <sub>3</sub>				
206	3-Toluanilide	126		111-3, 110 1	263, subl	86 6	108			184	114	160	
207	Angelanilide	126		45-6	185 (cor)					184	114	160	
208	β-Resorcylianilide (2,4-Dihydroxybenzanilide)	126 7		213d (rapid htng) 216, 217		188-9				184	114	160	
209	2-Ethylbutanilide	127, 127 5		-31 8	195					184	114	160	
210	Suberic acid monoamide	127		144 139 41		dt 85	dt 144 2		NH <sub>3</sub>				
211	4-Methoxyacetamide	127		16 6	118 2	78	86 0	58		240	130 127	154, 157	
212	Angelanilide	127 8		45 6	185 (cor)				NH <sub>3</sub>				
213	Phenylpropiolanilide	128, 126		136 7, subl		83				184	114	160	
214	Nicotinamide	128, 129, 129 31		237-8 subl					NH <sub>3</sub>				B p 150 60 <sup>s 10-4</sup> Chloroaurate, 205, N-Ethyl, 188-9, N isopropyl, 184 6
215	Pivalanilide	128 (cor), 132-3		35 5	163 4		75-6			184	114	160	
216	Suberic acid monoanilide	128-9		144, 139-41		dt 85	dt 144 2			184	114	160	
217	Isobutyramide	129, 127	210-1	-46 1	154 7		76 8		NH <sub>3</sub>				
218	2-Methoxybenzamide	129		100-1	200		113		NH <sub>3</sub>				Mercury deriv, 241
219	2-Bromo-4-nitroacetanilide	129		16 6	118 2	78	86 0	105		129	160		
220	Benzamide	130, 129	222 5- 3 5, 224	122 4	249	89	119		NH <sub>3</sub>				Mercury deriv, 222, Phthalimide, 168

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Xan-thyl-amide	Derived acid				Derived amine				Miscellaneous	
				M P, °C	B P, °C	p-Nitro benzyl ester	p Bromo-phenacyl ester	M P °C	B P °C	Acet amide	Benz amide		
221	3,4-Dimethylbenzamide	130		166, 164					NH <sub>3</sub>				
222	α,β-Dibromopropionamide	130, 133		67 (stab), 160 <sup>20</sup> 50 (un-stab)					NH <sub>3</sub>				
223	Anthranilanilide	131		147					184	114	160		
224	Bromoacetanilide	131		50	208	88			184	114	160		
225	2-Methoxybenzanilide	131		100-1	200		113		184	114	160		
226	Nicotinanilide	132, bz, 85 (+ 2H <sub>2</sub> O), w, 265 (anh)		237 8, subl					184	114	160		
227	2,2-Dimethylbutanamide	132, 103		-15 0	187, 190				184	114	160		
228	d,l-2,3-Dimethylbutanamide	132		-1 5	191 7				NH <sub>3</sub>				
229	3,3-Dimethylbutanilide	132		6 7	184, 96 <sup>26</sup>				184	114	160		
230	3,3-Dimethylbutanamide	132		6 7	184, 96 <sup>26</sup>				NH <sub>3</sub>				
231	2,5-Dichloroacetanilide	132		16 6	118 2	78	86 0	50		132	120		
232	Malonic acid monoanilide	132		134 8 9		dt 85 5			184	114	160		
233	Urea (Carbamide)	132 8	265, 274						NH <sub>3</sub>				Phthalimide, 188-90, Picrate, 148
234	2,4-Dimethylacetanilide	133, 130		16 6	118 2	78	86 0		217	133, 130	192		
235	Mesityleneamide (3,5-Dimethylbenzamide)	133		16 6					NH <sub>3</sub>				
236	4-Isopropylbenzamide	133		177, al					NH <sub>3</sub>				
237	α-Bromoisovaleramide	133		44	230d				NH <sub>3</sub>				
238	4-Chlorophenoxyacetamide	133		155-6, w, 158			136		NH <sub>3</sub>				
239	d,l-Mandelamide	133 4 (cor)		118		123-4			NH <sub>3</sub>				
240	N-(2-Naphthyl)acetamide	134		16 6	118 2	78	86 0	112		132	162		Br <sub>2</sub> → 1-Bromo deriv, 140 Mercury deriv, 245
241	3-Chlorobenzamide	134		158, 155		107	116		NH <sub>3</sub>				
242	Phenacetin (4-Aceto-phenetide)	134		16 6	118 2	78	86 0	2 3	248 254	137	173		10% HNO <sub>3</sub> → 3-Nitro deriv, 103
243	Chloroacetanilide	134, 136-7		α 61 3, β 56 2, γ 52 5	189		104		184	114	160		
244	2,3-Dimethylacetanilide	135		16 6	118 2	78	86 0		221-2	135	189		
245	Isovaleramide	135, 136	182-3	-30 0	176 5		68 0		NH <sub>3</sub>				
246	Acetyl salicylanilide	136		135 (rapid hting)	140d	90 5			184	114	160		
247	3-Bromobenzanilide	136		155		105	120		184	114	160		
248	Salicylanilide	136		158 3 (subl at 76)		97-8	140		184	114	160		
249	α-Hydroxyisobutyranilide	136		79	212	80 5	98		184	114	160		
250	N,N-Diacetyltetramethylenediamine	137		16 6	118 2	78	86 0	27	159	dt 137	dt 177		
251	Benzo-2-iodonanilide (N-Benzoyl-α-iodoaniline)	139		122 4 (subl at 100)	249	89	119	61, 58		109	139		
252	3-Ethoxybenzamide	139		137					NH <sub>3</sub>				
253	2,5-Dimethylacetanilide	139		16 6	118 2	78	86 0	15 5	213-5	139	140		
254	3-Aminobenzanilide	140		174d					184	114	160		

\* Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous
				M P, °C	B P, °C	p-Nitrobenzyl ester	p-Bromophenacyl ester	M P, °C	B P, °C	Acetamide	Benzamide	
255	2-Toluamide	140, 143	199	104-5, 107 8	259 <sup>751</sup>	90 7	57	NH <sub>3</sub>				Mercury deriv, 196
256	Trichloroacetamide	141	200 5	57-8	197 5	80		NH <sub>3</sub>				
257	2-Iodobenzanilide	141		162		111	143	184	114	160		
258	2-Bromobenzanilide	141		150		110	102	184	114	160		
259	3-Tolylurea	142						203	65	125		
260	2-Chlorobenzamide	142		142, 140		106	106	NH <sub>3</sub>				
261	Salicylamide	142		158 3 (subl at 76)		97-8	140	NH <sub>3</sub>				Mercury deriv, 190
262	Furamide	142-3	210	133 4, 132	230-2	133 5	138 5	NH <sub>3</sub>				
263	3-Nitrobenzamide	143, 142		140		141	132	NH <sub>3</sub>				
264	Iodoacetanilide	143-4		83				184	114	160		
265	3,5-Dimethylacetanilide	144, 140		16 6	118 2	78	86	220	144, 140	136		
266	2-Benzotoluidide (N-Benzoyl- <i>o</i> -toluidine)	144		122 4	249	89	119	200	110-11	146		KMnO <sub>4</sub> → Benzoylanthranilic acid, 177
267	3-Nitrosalicylamide	145 (hyd)		125				NH <sub>3</sub>				
268	2,4-Dichloroacetanilide	145		16 6	118 2	78	86 0	63	145	177		
269	<i>α-d</i> l-Phenylsuccinamide ( <i>β</i> form)	145		167-8, 84 (anh)				NH <sub>3</sub>				
270	4-Toluanilide	145, 148		179 80, 182 subl	275 (cor)	104 5	153	184	114	160		
271	Diethylmalonic acid monoamide	146		125		<i>di</i> 91		NH <sub>3</sub>				
272	Cyclohexancarboxanilide (Hexahydrobenzanilide)	146, 131		30-1	233			184	114	160		
273	Phenylurea	147	225					184	114	160		
274	N,N'-Dibenzoyltrimethylene-diamine	147		122 4	249	89	119	136	<i>mono</i> 126, <i>di</i> 101	<i>mono</i> 140, <i>di</i> 147		
275	Benzo-2-ethylanilide (N-Benzoyl- <i>o</i> -ethylaniline)	147		122 4	249	89	119	210-11	111	147		
276	2,4,6-Trichloroacetanilide	148		16 6	118 2	78	86 0	78	148	172		
277	<i>α</i> -Bromoisobutyramide	148		48-9	198-200			NH <sub>3</sub>				
278	Cinnamide	148, 142		133	300	116 8	145 6	NH <sub>3</sub>				
279	Succinic acid monoanilide	148 5		185, 182 8	235 d	<i>di</i> 88	<i>di</i> 211	184	114	160		
280	N-Cyclohexylbenzamide	149		122 4	249	89	119	134	104	149		
281	Benzylurea	149						184-5	60	105		
282	Phthalic acid monoamide (Phthalamic acid)	149		200-6, 197 (sealed tube), 230 (rapid htng)		<i>di</i> 155 5	<i>di</i> 152 8	NH <sub>3</sub>				
283	<i>β</i> -Benzoylpropionanilide	150, 145		116				184	114	160		
284	Ethylmalonic acid monoanilide	150		111		75		184	114	160		
285	2-Chlorophenoxyacetamide	150		145-6, w				NH <sub>3</sub>				
286	Adipic acid monoanilide	151 3		153-4 (cor)	216 <sup>18</sup>	106	154 5, 152 6	184	114	160		
287	Cinnamanilide	151, 153		133	300	116 8	145 6	184	114	160		Acid KMnO <sub>4</sub> → Benzoic acid, 122 4

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Xan-thyl amide	Derived acid				Derived amine				Miscellaneous
				M P, °C	B P, °C	<i>p</i> Nitro benzyl ester	<i>p</i> -Bromo phenacyl ester	M P, °C	B P, °C	Acet-amide	Benz-amide	
288	4-Fluoroacetanilide	152		16 6	118 2	78	86 0	-1	186	152	185	
289	<i>d l</i> -Mandelanilide	152		118		123 4			184	114	160	
290	4-Acetotoluidide (N-Acetyl- <i>p</i> -toluidine)	153, 147		16 6	118 2	78	86 0	45	200	147	158	KMnO <sub>4</sub> → 4-Acetamido-benzoic acid, 256, Br <sub>2</sub> → 3-Bromo deriv, 117
291	N-Methyl-4-nitroacetanilide	153		16 6	118 2	78	86 0	152		153	112	
292	Veratranilide	154		181					184	114	160	
293	4-Fluorobenzamide	154		182, 182 6					NH <sub>3</sub>			
294	3-Nitrobenzanilide	154		140		141	132		184	114	160	
295	Benzilamide	154-5, 155		150		99 5	152		NH <sub>3</sub>			
296	3-Nitrosalicylamide	155, 145		125 (+ H <sub>2</sub> O)					NH <sub>3</sub>			
297	2,5-Dichlorobenzamide	155		153					NH <sub>3</sub>			
298	2-Bromobenzamide	155		150		110	102		NH <sub>3</sub>			Mercury deriv, 242
299	Dibenzylacetanilide	155		89					184	114	160	
300	2-Nitrobenzanilide	155		146		112	107		184	114	160	
301	3-Bromobenzamide	155		155		105	120		NH <sub>3</sub>			Mercury deriv, 235
302	N-(1-Naphthyl) acetanilide	155, 159 6		131, 135					184	114	160	
303	Phthalonamide ( <i>β</i> form)	155d		146					NH <sub>3</sub>			
304	3-Nitroacetanilide	155		16 6	118 2	78	86 0		114	<i>mono</i> 155, <i>di</i> 76	<i>mono</i> 155, <i>di</i> 150	
305	Pimelic acid dianilide	155-6		104-5, <i>subl</i>	223 <sup>15</sup>		<i>di</i> 136 6		184	114	160	
306	Pivalamide	155-7, 153-4		35 5	163-4		75-6		NH <sub>3</sub>			
307	N-Phenylsuccinimide	156		185, 182 8	235d	<i>di</i> 88	<i>di</i> 211		184	114	160	
308	Dibromoacetamide	156		48	232-5				NH <sub>3</sub>			
309	L-Malamide	156 5-8 0		100-1		<i>mono</i> 87 2, <i>di</i> 124 5	<i>di</i> 179		NH <sub>3</sub>			
310	Phenylacetamide	156, 157	196	76 5, <i>subl</i>	256 5 (cor)	65	89		NH <sub>3</sub>			
311	3-Hydroxybenzanilide	157, 155		200, <i>subl</i>		106-8	176, 176 1 4		184	114	160	
312	Succinic acid monoamide (Succinamic acid)	157		185, 182 8	235d	<i>di</i> 88	<i>di</i> 211		NH <sub>3</sub>			
313	N-Acetylindole	157-8		16 6	118 2	78	86	52	253	157-8	68	
314	<i>d l</i> -Phenylsuccinamide ( <i>α</i> form)	158		167-8					NH <sub>3</sub>			
315	4-Benzotoluidide (N-Benzoyl- <i>p</i> -toluidine)	158		122 4	249	89	119	45	200	147	158	CrO <sub>3</sub> → 4-Benzamido benzoic acid, 278
316	N-(1-Naphthyl) acetamide	159		16 6	118 2	78	86 0	50		159	160	Br <sub>2</sub> → 4-Bromo deriv, 193, Fuming HNO <sub>3</sub> → dinitro deriv, 250

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous	
				M P, °C	B P, °C	p-Nitro benzyl ester	p Bromo phenacyl ester	M P, °C	B P, °C	Acet amide	Benz- amide		
317	4-Toluamide	159, 160	224-5	179-80, 182, subl	275 (cor)	104.5	153		NH <sub>3</sub>				Mercury deriv, 260
318	Crotonamide	161, 158		72, w	189 (cor)	67.4	95.6		NH <sub>3</sub>				
319	N-(1-Naphthyl) benzamide	161		122.4	249	89	119	50		159	160		
320	N-(2-Naphthyl) benzamide	162		122.4	249	89	119	112		132	162		
321	4-Aminoacetanilide	162		16.6	118.2		86.0	140, 147	267	mono 162.3, di 304	mono 128, di 300		Azo-β-naphthol deriv, 261
322	4-Hydroxybenzamide	162 (hyd)		215, 213, 4, 210		180-2	191.5 (cor) 184		NH <sub>3</sub>				
323	Benzanilide	163, 160		122.4	249	89	119		184	114	160		Br <sub>2</sub> →4-Bromo deriv, 204
324	1-Naphthanilide	163, 164		161.2 (cor)			135.5		184	114	160		
325	Trichlorolactanilide	164		124					184	114	160		
326	Veratramide	164		181					NH <sub>3</sub>				
327	2-Benzoylbenzamide	165		128, 91 (hyd)		100.4			NH <sub>3</sub>				
328	L-Glutamamide	165		211 (rapid htng), 197 (slow htng)					NH <sub>3</sub>				
329	Protocatechuanilide	166		199-200d			188		184	114	160		
330	4-Ansamide	167, 163		184.6, 184.2 (cor)	275-80	132	152		NH <sub>3</sub>				Mercury deriv, 222
331	4-Bromoacetanilide	167, 168		16.6	118.2	78	86.0	66	245	168	204		
332	Acetylanthranililide	167		185.6					184	114	160		
333	Diphenylacetamide	168		148					NH <sub>3</sub>				
334	α-Benzoyl-β-phenylhydrazine	168		122.4	249	89	119	19.23	243	128	168		
335	2-Furanacrylamide (β-(2-Furyl)-acrylic acid)	168-9		141	286				NH <sub>3</sub>				
336	Piperonylamide	169		229, 228					NH <sub>3</sub>				
337	d l-Tropamide	169		117-8					NH <sub>3</sub>				
338	Methyliminodiacetic acid monoamide	169		227d					NH <sub>3</sub>				
339	Methyliminodiacetic acid diamide	169		227d					NH <sub>3</sub>				
340	4-Hydroxyacetanilide	169		16.6	118.2	78	86.0	184, 186		mono 168, di 150	N-mono 216-7, N,O-di 234		
341	4-Ansamilide	169-71		184.6, 184.2 (cor)	275-80	132	152		184	114	160		
342	3-Hydroxybenzamide	170, 167		200 subl		106.8	176, 176.7-4		NH <sub>3</sub>				
343	Sebacic acid monoamide	170		33, subl	243 <sup>15</sup>	di 73.5, 72.6	di 147		NH <sub>3</sub>				
344	cis-Aconitanilide	170d		125			tri 186		184	114	160		

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No.	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous	
				M.P., °C	B.P., °C	<i>p</i> -Nitrobenzyl ester	<i>p</i> -Bromophenacyl ester	M.P., °C	B.P., °C	Acetamide	Benzamide		
345	Malonic acid diamide (Malondiamide)	170	270	134.8-9		<i>di</i> : 85.5			NH <sub>3</sub>				
346	D,L-Phenylsuccinic acid monoanilide ( $\beta$ form)	170		167-8; 84 (anh.)					184	114	160		
347	4-Ethoxybenzanilide	170; 172		198; 195-6					184	114	160		
348	2-Naphthylanilide	171; 173		184; 185.5					184	114	160		
349	N,N'-Diacetylenethylenediamine	172		16.6	118.2	78	86.0	8.5	116	<i>di</i> : 172	<i>di</i> : 244		
350	Benzo-2,4,6-trichloroanilide (N-Benzoyl-2,4,6-trichloroaniline)	172		122.4	249	89	119	78		148	172		
351	Azelaic acid diamide	172		106.5	> 360 sl. d.; 237 <sup>15</sup>	<i>di</i> : 43.8	<i>di</i> : 130.6		NH <sub>3</sub>				
352	Maleic acid monoamide (Maleamic acid)	172-3; 153 sl.d.		137-8; 130 (+ 3% fumaric acid)		<i>di</i> : 91 (cor.)	168-70; 190		NH <sub>3</sub>				
353	4-Phenetylurea (Dulcin)	173						2-3	248; 254	137	173		
354	4-Benzophenetidine (N-Benzoyl- <i>p</i> -phenetidine)	173		122.4	249	89	119	2-3	248; 254	137	173		
355	Benzylanilide	174-5		150		99.5	152		184	114	160		
356	Pimelic acid diamide	175		104-5, subl.	223 <sup>15</sup>		<i>di</i> : 136.6		NH <sub>3</sub>				
357	<i>d,l</i> -Phenylsuccinic acid monoanilide ( $\alpha$ form)	175		167-8; 84 (anh.)					184	114	160		
358	4-Hydroxyphenylacetamide	175		148-50; 148, w.					NH <sub>3</sub>				
359	Citraconic acid dianilide	175.5		92-3; 22d.		70.6			184	114	160		
360	Glutaric acid diamide	175-6		98	302-4	<i>di</i> : 69	<i>di</i> : 139.8		NH <sub>3</sub>				
361	2-(4-Toluy) benzamide	175-6		139-140					NH <sub>3</sub>				
362	2-Nitrobenzamide	176; 175		146		112	107		NH <sub>3</sub>				
363	Phthalonic acid monoanilide	176		146					184	114	160		
364	N,N-Dibenzoyltetramethylenediamine	177		122.4	249	89	119	27	159	<i>di</i> : 137	<i>di</i> : 177		
365	Acetylanthranilamide	177		185, ac. a.					NH <sub>3</sub>				
366	2,6-Dimethylacetanilide	177		16.6	118.2	78	86.0		215; 218	177	168		
367	D-Camphoric acid monoamide	177		187.5-8.0		65.5			NH <sub>3</sub>				
368	Mesaconic acid diamide	177		204.5 (cor.), subl.		<i>di</i> : 134 (cor.)			NH <sub>3</sub>				
370	4-Cyanobenzanilide	179		219; 214		189			184	114	160		
371	N-Benzylphthalamide	179		200-6; 191 (sealed tube); 230 rapid htng.)		<i>di</i> : 155.5	<i>di</i> : 152.8		184-5	60	105		
372	4-Chloroacetanilide	179		16.6	118.2	78	86.0	72		179	192		
373	$\alpha$ -Phthalonamide	179d.		146					NH <sub>3</sub>				

\*Derivative data given in order: m.p., crystal color, solvent from which crystallized.

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous	
				M P, °C	B P, °C	<i>p</i> Nitro benzyl ester	<i>p</i> Bromo-phenacyl ester	M P, °C	B P, °C	Acetamide	Benzamide		
374	2,4-Dimethylbenzamide	179-81		127, 90 (+ H <sub>2</sub> O)					NH <sub>3</sub>				
375	D-Tartaric acid monoanilide	180d		169-71		<i>dt</i> 163	<i>dt</i> 204		184	114	160		
376	$\alpha$ -Acetyl- $\beta$ -methylurea	180		16-6	118-2	78	86-0		-6	28	80		
377	Diphenylacetanilide	180		148					184	114	160		
378	3,5-Dinitrosalicylamide	181		182					NH <sub>3</sub>				
379	1-Naphthylacetamide	181		131, 135					NH <sub>3</sub>				
380	Maleic acid diamide	181, 180		137		<i>dt</i> 91 (cor)	168-70, 190		NH <sub>3</sub>				
381	<i>unsym</i> -Dimethyl urea	182	225						7		41		
382	Thiourea	182							NH <sub>3</sub>				
383	Hippuramide	183		187		136	151		NH <sub>3</sub>				
384	4-Tolylurea	183						45	200	147	158		
385	3,5-Dinitrobenzamide	183		204-5		157	159		NH <sub>3</sub>				
386	2-Iodobenzamide	184		162		111	143		NH <sub>3</sub>				
387	4-Iodoacetanilide	184		16-6	118-2	78	86-0	67-8		184	222		
388	Benzo-4-fluoroanilide (N-Benzoyl- <i>p</i> -fluoroaniline)	185		122-4	249	89	119	-1	186	152	185		
389	N,N'-Diacetyl- <i>o</i> -phenylene-diamine	185		16-6	118-2	78	86-0	102		<i>dt</i> 185	<i>dt</i> 301		
390	2-Nitrocinnamamide	185		240		132	141		NH <sub>3</sub>				
391	Mesaconic acid dianilide	185-7		204-5 (cor)		<i>dt</i> 134 (cor)			184	114	160		
392	Citraconic acid diamide	185-7		92-3, 92d		<i>dt</i> 70-6			NH <sub>3</sub>				
393	Chlorofumaranylde	186		191-2		<i>dt</i> 138-5			184	114	160		
394	3-Iodobenzamide	186		187		121	128		NH <sub>3</sub>				
395	Suberic acid dianilide	186-7		144, 139- 41		<i>dt</i> 85	<i>dt</i> 144-2		184	114	160		
396	Maleic acid dianilide	187		137		<i>dt</i> 91 (cor)	168-70, 190		184	114	160		
397	Maleic acid monoanilide	187		137		<i>dt</i> 91 (cor)	168-70, 190		184	114	160		
398	Hippuric acid	187-5		122-4	249	89	119	Glycine 228 30, 262d 53-4		206	187-5	Acetamide, 136, Benzamide, 151	
399	<i>unsym</i> -Diphenylurea	189	180							101	180		
400	Aconitic acid dianilide	189		194-5d (cor)			<i>tri</i> 186		184	114	160		
401	<i>meso</i> -Tartaric acid diamide	189-90, 187		140		93			NH <sub>3</sub>				
402	4-Bromobenzamide	189-90		251-3		180			NH <sub>3</sub>				Mercury deriv., 266
403	Itaconic acid dianilide	190, 185		165		<i>dt</i> 90-6	<i>dt</i> 117-4		184	114	160		
404	Picramide	190		122-5					NH <sub>2</sub>				Acetamide, 230, Benzamide, 196
405	N,N'-Diacetyl- <i>m</i> -phenylene-diamine	191		16-6	118-2	78	86-0	63		<i>mono</i> 87-9, <i>dt</i> 191	<i>mono</i> 125 <i>dt</i> 240		
406	Itaconic acid diamide	191-2- 8		165		<i>dt</i> 90-6	<i>dt</i> 117-4		NH <sub>3</sub>				
407	Mucic acid monoamide	192d		214d, varies with htng rate, 223- 255		310	225		NH <sub>3</sub>				

\*Derivative data given in order m.p., crystal color, solvent from which crystallized



TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous
				M P °C	B P °C	p-Nitro benzyl ester	p-Bromo phenacyl ester	M P °C	B P °C	Acet amide	Benz- amide	
408	4-Nitrophthalanilide	192	228	165					184	114	160	
409	2-Tolylurea	192							200	110-11	146	
410	Benzo-4-chloroaniline (N Benzoyl p-chloroaniline)	192		122 4	249	89	119		72	179, 172	192	
411	Buret	192d								NH <sub>3</sub>		
412	2-Naphthamide	192 195		184					NH <sub>3</sub>			
413	D-Camphoric acid diamide	193		185 5					NH <sub>3</sub>			
414	4-Chlorobenzanilide	194		187 5 8 0		65 5			NH <sub>3</sub>			
415	4-Coumaramide	194		243, 240		129 5	126		184	114	160	
				210 3					NH <sub>3</sub>			
				206 (anh)								
416	2-Benzoylbenzanilide	195		128 91 (+1 H <sub>2</sub> O)		100 4			184	114	160	
417	3-Nitrocinnamamide	196		199		174	178, 173		NH <sub>3</sub>			
418	D-Tartaric acid diamide	196d		169 71		di 163	di 204		NH <sub>3</sub>			
419	2-Methyl-4-nitroacetanilide	196 202		16 6	118 2	78	86 0	130		202		
420	L-Malanilide (Hydroxysuccin anilide)	197		100 1		mono 87 2 di 124 5	di 179		184	114	160	
421	4-Hydroxybenzanilide	198		215		180 2	191 5		184	114	160	
		196 7		213 4			(cor)					
422	4-Nitrophenylacetamide	198		153			207		NH <sub>3</sub>			
423	4-Nitrophenylacetanilide	198		153			207	147 8		215	di 193, 203	
424	Cyanoacetanilide	198-9		66					184	114	160	
425	Citric acid trianilide	199 192 (+1 H <sub>2</sub> O)		100 153 (anh)		tri 102	tri 148		184	114	160	
426	4-Nitrophthalamide	200d		165					NH <sub>3</sub>			
427	cis-Aconitic acid dianilide	200		125			tri 186		184	114	160	
428	Methylsuccinic acid dianilide	200		115					184	114	160	
429	4-Nitrobenzamide	200	232	241		168	137		NH <sub>3</sub>			
430	2-Naphthylacetamide	200 205		141 2 143					NH <sub>3</sub>			
431	Isatin	200 1									Acetamide, 147	
432	3-Nitrophthalic acid diamide	201d		218		189			NH <sub>3</sub>			
433	Sebacic acid dianilide	201		33, subl	243 <sup>15</sup>	di 73 5 72 6	di 147		184	114		160
434	1-Napthoamide	202		161 2 (cor)			135 5		NH <sub>3</sub>			
435	4-Ethoxybenzamide	202		198 195-6					NH <sub>3</sub>			
436	2,4-Dinitrobenzamide	203		183		142	158		NH <sub>3</sub>			
437	D-Camphoric acid monoanilide	204		187 5 8 0		65 5			184	114	160	
438	Benzo-4-bromoanilide (N Benzoyl-p bromoaniline)	204		122 4	249	89	119	66	245	168	204	
439	4-Nitrocinnamamide	204, 217		285		186	191		NH <sub>3</sub>			
440	N-Phenylphthalimide	205		200 6 191 (sealed tube), 230 (rapid htng)		di 155 5	di 152 8		184	114	160	

\*Derivative data given in order m p, crystal color solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous	
				M P °C	B P °C	p-Nitro benzyl ester	p-Bromo phenacyl ester	M P °C	B P °C	Acet amide	Benz amide		
441	Carballylic acid triamide	207d 205 7d		166			tri 138 2		NH <sub>3</sub>				
442	Gallanide	207		253 4d 222 40d		141	134		184	114	160		
443	Phthalonic acid diamide	208		146					184	114	160		
444	Hippuranilide	208		187		136	151		184	114	160		
445	2-Coumaramide	209d		207 8, subl		152 5			NH <sub>3</sub>				
446	Sebacic acid diamide	210 208		133, subl	243 <sup>15</sup>	dt 73 5 72 6	dt 147		NH <sub>3</sub>				
447	4-Iodobenzanilide	210		270, 265		141	146		184	114	160		
448	Citric acid triamide	210-5		153 (slow htng )		tri 102	tri 148		NH <sub>3</sub>				
449	4-Nitrobenzanilide	211 204		241		168	137		184	114	160		
450	d,l-Phenylsuccinic acid diamide	211		167 8 84 (anh )					NH <sub>3</sub>				
451	Protocatechuamide	212		199 200d		188			NH <sub>3</sub>				
452	2,2'-Diphenic acid diamide	212		227 233		dt 187 182 6			NH <sub>3</sub>				
453	4-Nitroacetanilide	213 4		16 6	118 2	78	86 0	147 8		215	dt 199 208		
454	Ethylmalonic acid diamide	214		111		75			NH <sub>3</sub>				
455	3-Nitrophthalimide	216		218		189			NH <sub>3</sub>				
456	Suberic acid diamide	216 7		144 139 41		dt 85	dt 144 2		NH <sub>3</sub>				
457	Methylmalonic acid diamide	217 206		137 138d					NH <sub>3</sub>				
458	4-Iodobenzamide	217		270 265		141	146		NH <sub>3</sub>				
459	Benzylmalonic acid diamide	217		117d 121		dt 119 5			184	114	160		
460	4-Hydroxy-2-naphthamide	217 8		225 6					NH <sub>3</sub>				
461	Acetylurea	218		16 6	118 2	78	86 0		NH <sub>3</sub>				
462	3-Hydroxy-2-naphthamide	218		222 3 (cor )					NH <sub>3</sub>				
463	sym -Di-3-tolylurea	218							203	65	125		
464	Phthalic acid diamide	220		200-6, 191 (sealed tube) 230 (rapid htng )		dt 155 5	dt 152 8		NH <sub>3</sub>				
465	Mucic acid diamide	220		214d, varies with htng rate, 223-255		310	225		NH <sub>3</sub>				
466	Saccharin	220	198 9	206					NH <sub>3</sub>				
467	Adipic acid diamide	220, 229		153-4 (cor )	216 <sup>15</sup>	106	152 6 154 5		NH <sub>3</sub>				
468	d,l-Phenylsuccinic acid diamide	222		167-8, 84 (anh )					184	114	160		

\* Derivative data given in order m p, crystal color solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous	
				M P °C	B P °C	<i>p</i> Nitro benzyl ester	<i>p</i> Bromo phenacyl ester	M P °C	B P °C	Acet amide	Benz amide		
469	<i>β</i> -Resorcylamide	222		213d (rapid htng ) 216d 217		188 9			NH <sub>3</sub>				
470	4-Cyanobenzamide	223		219 214		189			NH <sub>3</sub>				
471	Diethylmalonic acid diamide	224		125	302 4	<i>dt</i> 91			NH <sub>3</sub>				
472	Glutaric acid dianilide	224		98		<i>dt</i> 69	<i>dt</i> 139 8		184	114	160		
473	5-Nitrosalicylanilide	224		229 30					184	114	160		
474	5-Nitrosalicylamide	225		229 30					NH <sub>3</sub>				
475	Benzylmalonic acid diamide	225		117d 121		<i>dt</i> 119 5			NH <sub>3</sub>				
476	Methylsuccinic acid diamide	225		115					NH <sub>3</sub>				
477	Malonic acid dianilide	225 227, 230		134 8-9		<i>dt</i> 85 5			184	114	160		
478	<i>d l</i> -Tartaric acid monoamide	226		203 4 (+1 H <sub>2</sub> O) 205 6 (anh )		<i>dt</i> 147 6			NH <sub>3</sub>				
479	D-Camphoric acid dianilide	226		187 5 8 0		65 5			184	114	160		
480	Succinic acid dianilide	230, 226		185 182 8	235d	<i>dt</i> 88	<i>dt</i> 211		184	114	160		Heat above m p → succinanyl, 155 6 + aniline, b p 184
481	2,2-Diphenanilide	230		227 229 233		<i>dt</i> 187 182 6			184	114	160		
482	Phthalimide	233 5 (cor ) 238	176 7	200 6 191 (sealed tube) 230 (rapid htng )	249	89	119	122 119		232	198, 204		
483	3,5-Dinitrobenzamide	234		204 5		157	159		184	114	160		
484	3-Nitrophthalic acid dianilide	234		218		189			184	114	160		
485	Terephthalic acid monoanilide	234 7		300, subl with out melting		<i>dt</i> 263 5	<i>dt</i> 225		184	114	160		
486	<i>d l</i> -Tartaric acid monoanilide	236		203 4 (+1 H <sub>2</sub> O) 205 6 (anh )					184	114	160		
487	N-Benzylacrylamide	237		13	141, 140				184 5	60	105		
488	Carbanilide ( <i>sym</i> -Diphenyl urea)	238, 240							184	114	160		
489	Muonic acid diamide	240d		289d (slow htng ) 306 (rapid htng )					NH <sub>3</sub>				
490	Adipic acid dianilide	241		153-4 (cor )	216 <sup>15</sup>	106	152 6, 154 5		184	114	160		

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous
				M P, °C	B P, °C	<i>p</i> -Nitrobenzyl ester	<i>p</i> -Bromophenacyl ester	M P, °C	B P, °C	Acetamide	Benzamide	
491	<i>N,N'</i> -Dibenzoyl ethylenediamine	244		122 4	249	89	119	8 5	116	<i>di</i> 172	<i>di</i> 244	
492	Gallamide	245		253-4d, 222 40d		141	134		NH <sub>3</sub>			
493	3-Hydroxy-2-naphthanilide	249 (cor), 244		222-3 (cor)					184	114	160	
494	<i>sym</i> -Di-2-tolylurea	250							200	110 1	146	
495	Carballylic acid trianilide	252		166			<i>tri</i> 138 2		184	114	160	
496	Phthalic acid dianilide	253 5		200 6, 191 (sealed tube), 230 (rapid htng)		<i>di</i> 155 5	<i>di</i> 152 8		184	114	160	
497	Oxalic acid dianilide	254		189 5 (anh), 101 (+2 H <sub>2</sub> O) (rapid htng)		<i>di</i> 204			184	114	160	
498	Succinic acid diamide	255, 260d	275	185, 182 8	235d	<i>di</i> 88	<i>di</i> 211		NH <sub>3</sub>			
499	2,4,6-Trinitrobenzamide	264d		228					NH <sub>3</sub>			
500	D-Tartaric acid dianilide	264d		169-71		<i>di</i> 163	<i>di</i> 204		184	114	160	
501	Fumaric acid diamide	266d		293 5 286-7 (sealed tube), 200, subl		150 8			NH <sub>3</sub>			
502	<i>sym</i> -Di-4-tolylurea	268						45	200	147	158	
503	Isophthalic acid monoamide	280		348, subl		202 5	179 1		NH <sub>3</sub>			
504	Isophthalic acid diamide	280		348, subl		202 5	179 1		NH <sub>3</sub>			
505	Acetylenedicarboxylic acid diamide	294d		179					NH <sub>3</sub>			
506	Mucic acid monoanilide	310		214, varies with htng rate, 223-255		310	225		184	114	160	
507	<i>N,N'</i> -Diacetyl <i>p</i> -phenylenediamine	310		16 6	118 2	78	86 0	140, 147	267	<i>mono</i> 162-3, <i>di</i> 304	<i>mono</i> 128, <i>di</i> 300	
508	Fumaric acid dianilide	314		286 7 (sealed tube), 293-5, 200, subl		150 8			184	114	160	
509	<i>N,N'</i> -Diacetylbenzidine	317		16 6	118 2	78	86 0	127		<i>mono</i> 199, <i>di</i> 317	<i>mono</i> 203-5, <i>di</i> 352	

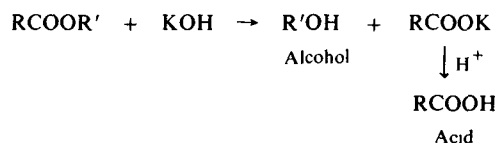
\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES  
 b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous	
				M P, °C	B P °C	<i>p</i> Nitro benzyl ester	<i>p</i> -Bromo-phenacyl ester	M P, °C	B P, °C	Acet- amide	Benz- amide		
510	Terephthalic acid dianilide	334 7		300, subl without melting		<i>di</i> 263 5	<i>di</i> 225						
511	N,N'-Dibenzoylbenzidine	352		122 4	249	89	119	127		<i>mono</i> 199 <i>di</i> 317	<i>mono</i> 203 5 <i>di</i> 352		
512	Trimesic acid triamide	365d		380 (cor )			<i>tri</i> 197 (sealed tube)		NH <sub>3</sub>				
513	Oxalic acid diamide	419d (sealed tube)		189 5 (anh ), 101 (+2 H <sub>2</sub> O), (rapid htng )		<i>di</i> 204			NH <sub>3</sub>				

\*Derivative data given in order m p , crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE XVI

*Hydrolysis to the corresponding acid and alcohol \**

From the ester with aqueous sodium or potassium hydroxide

*For directions and examples see* Cheronis, p 539, Linstead, p 42, Vogel, pp 390, 391, 786, Wild, p 187

From the ester and potassium hydroxide in anhydrous or aqueous diethylene glycol

*See* Cheronis, p 538, C E Redemann and H J Lucas, *Ind Eng Chem, Anal Ed*, **9**, 514 (1937)

From the ester with sodium methoxide in methanol or with sodium ethoxide in ethanol

*See* Linstead, p 40, Vogel, p 391

From an  $\alpha$ -hydroxy ester in water without catalyst

*See* A Findlay and E M H Hickmans, *J Chem Soc*, **95**, 1004 (1909)

*Saponification equivalent*

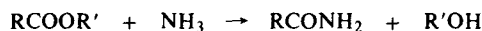
The saponification equivalent (S E) measures the number of equivalents of base required for complete hydrolysis of an ester. It is defined as

$$\text{S E} = \frac{\text{Milligrams ester taken for hydrolysis}}{\text{Milliequivalents of KOH required for complete hydrolysis}}$$

*For directions and examples see* Cheronis, pp 975-6, Shriner, p 235, Vogel, p 392

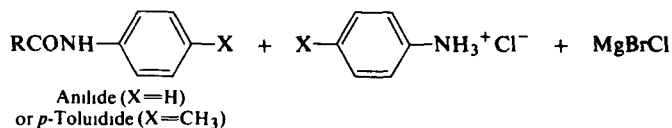
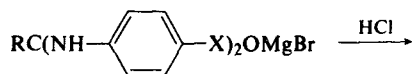
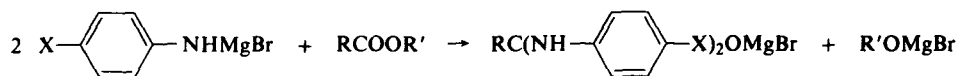
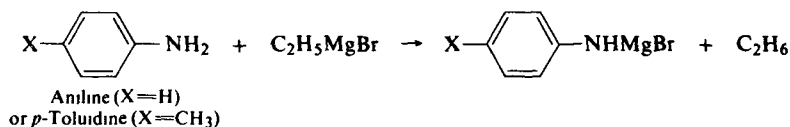
*NOTE* For directions and examples for preparation of derivatives of the carboxylic acids formed on hydrolysis of esters see explanations and references to Tables XII, XIII and XIV, pp 186, 187, 188, 189

For directions and examples for preparation of derivatives of alcohols formed on hydrolysis of esters see explanations and references to Table VI, pp 77, 78, 79

*Amide*

From the ester with aqueous or alcoholic ammonia

*For directions and examples see* Linstead, p 42, Wild, p 188

*Anilide and p-Toluidide*

From the ester and the N-magnesium bromide derivative of aniline or *p*-toluidide (prepared from the amine and ethylmagnesium bromide) in anhydrous ether

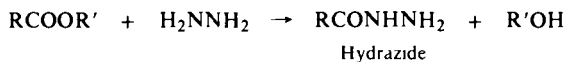
*For directions and examples see* Cheronis, p 537, Linstead, pp 42-3, Vogel, p 394, Wild, p 190, C F Koelsch and D Tenenbaum, *J Amer Chem Soc*, **55**, 3049 (1933), D V N Hardy, *J Chem Soc*, 398 (1936)

**\*Derivatives recommended for first trial**

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives

EXPLANATIONS AND REFERENCES TO TABLE XVI (Continued)

Hydrazide



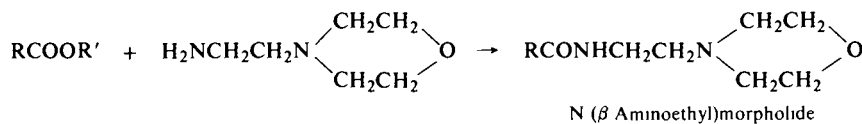
From the ester and 90% hydrazine hydrate

For directions and examples see Linstead, p 42, Wild, p 191

From the ester and 85% hydrazine hydrate in alcohol

See Cheronis, p 535, Shriner, p 237, Vogel, p 395, P P T Sah, *Rec Trav chim*, 59, 1036 (1940)

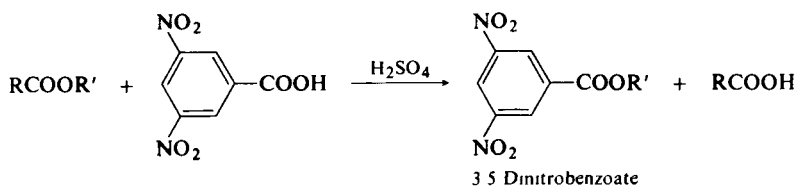
N-(β-Aminoethyl)morpholide \*



From the ester and N-(β-aminoethyl)morpholine in ethylene glycol or without solvent

For directions and examples see Cheronis, p 536, R W Bost and L V Mullen, *J Amer Chem Soc*, 73, 1967 (1951)

3,5-Dinitrobenzoate \*



From the ester with 3,5-dinitrobenzoic acid with a catalytic amount of sulfuric acid

For directions and examples see Linstead, p 43, Shriner, p 238, Vogel, p 393, W B Renfrow and A Chaney, *J Amer Chem Soc*, 68, 150 (1946)

From the ester with 3,5-dinitrobenzoyl chloride and pyridine

See Cheronis, p 538

\*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids  
a) Liquids. 1) (Listed in order of increasing b.p.).\*

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p Tolu- dide	3,5 Di- nitro- benzoate	Miscellaneous	
						Equiv alent	Acid		Alcohol					
							M P, °C	B P, °C	M P °C					B P °C
1	Ethyl nitrite	17			0 900 <sup>15</sup>	75			-117 3	78 32				
2	Methyl formate	31 50	-99	1 34648 <sup>15</sup> He (yel)	0 97421	60	8 4	100 7	-97	64 65	2 55	53	93, al 108 (cor), al	
3	Ethyl formate	54 15	-79 4	1 35975	0 92247	74	8 4	100 7	-117 3	78 32	2 55	53	93, al	
4	Methyl acetate	57 1	-98 7	1 36170 1 3639	0 9274 0 93347	74	16 6	118 2	-97	64 65	82	153 147	108 (cor), al	
5	Ethyl trifluoro- acetate	60 5		1 3093 <sup>15</sup>		142	-15 25	72 4	-117 3	78 32			93, al	
6	Methyl nitrate	65			1 217 <sup>15</sup>	77			-97	64 65			108 (cor), al	
7	Isopropyl formate	71, 68			0 8728	88	8 4	100 7	-89 5	82 4	2 55	53	123, pet eth	
8	Butyl nitrite	75			0 911	103			-90 2	117 6 116			64, 62 5	
9	Methyl chloro- formate	75		1 38675	1 2231	94 5			-97	64 65			108 (cor), al	
10	Ethyl acetate	77 15	-83 6	1 372	0 90055	88	16 6	118 2	-117 3	78 32	82	153 147	93, al	
11	Methyl propionate	79 65	-87 5	1 3779	0 9151	88	-20 8	141	-97	64 65	81 81 3, 79	126 123	108 (cor), al	
12	Methyl acrylate	80 3		1 3984	0 961 <sup>19 2</sup>	86	13	140, 141	-97	64 65	84-5, pet eth	141	108 (cor), al	Polymerizes on standing
13	n-Propyl formate	80 85, 81	-92 9	1 37789	0 9071, 0 918	88	8 4	100 7		97 1	2 55	53	74, pet eth	
14	tert-Butyl formate	83				102	8 4	100 7	25 5	82 5	2 55	53	142, pet eth	
15	Allyl formate	83 6			0 946	86	8 4	100 7		97 1	2 55	53	49-50	
16	Ethyl nitrate	87	-112		1 106	91			-117 3	78 32			93, al	
17	Isopropyl acetate	88 9, 91	-73 4	1 3740 <sup>25</sup>	0 872	102	16 6	118 2	-89 5	82 4	82	153, 147	123, pet eth	
18	Dimethyl carbon- ate (Methyl car- bonate)	90 5		1 3687	1 0702 1 0694	90			-97	64 65			108 (cor), al	
19	Methyl iso- butyrate	92 6, 92 26	-87 7, -84 7	1 3840	0 8906	102	-46 1	154 7	-97	64 65	128, 129	108 5- 9 5	108 (cor), al	
20	Ethyl chloro- formate	93		1 3974	1 13519	108 5			-117 3	78 32			93, al	
21	sec-Butyl formate	97		1 384	0 884	102	8 4	100 7		99 5	2 55	53	76	
22	tert-Butyl acetate	97 8		1 386	0 867	116	16 6	118 2	25 5	82 5	82	153, 147	142, pet eth	
23	Isobutyl formate	98 4	-95 8	1 38568	0 88535, 0 8755	102	8 4	100 7		108 1	2 55	53	87	
24	Isoamyl nitrite	99		1 38708 <sup>21</sup>	0 880 <sup>15</sup>	117			-117	132			61	
25	Ethyl difluoro- acetate	99		1 3463		124		134 5	-117 3	78 32	52		93, al	

\*Derivative data given in order m p, crystal color, solvent from which crystallized



**TABLE XVI. ORGANIC DERIVATIVES OF ESTERS**  
**Including esters of inorganic acids**  
**a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p Toluene	3,5-Dinitrobenzoate	Miscellaneous	
						Equiv- alent	Acid		Alcohol					
							M P, °C	B P, °C	M P °C					B P, °C
26	Methyl methacrylate	99, 100	-50	1.413	0.936	100	16	161	-97	64.65	102.6		108 (cor) al	Polymerizes on standing or heating, 4-Bromoanilide, 116
27	Ethyl propionate	99.1	-73.85	1.3853	0.8889	102	-20.8	141	-117.3	78.32	81, 81.3, 79	126, 123	93, al	N-(β-Aminoethyl)morpholide, 85
28	Ethyl acrylate	101		1.4059 <sup>19,4</sup>	0.9136 <sup>15</sup>	100	13	141	-117.3	78.32	84-5, pet eth	141	93, al	Polymerizes on standing or heating
29	Methyl pivalate (Methyl trimethylacetate)	101		1.4228	0.891 <sup>0</sup>	116	35.5	163-4	-97	64.65	155.7, 153.4, et ac - pet eth	119.20	108 (cor), al	
30	n-Propyl acetate	101.55	-95	1.38468	0.8834	102	16.6	118.2		97.1	82	153, 147	74, pet eth	
31	Methyl n-butyrate	102.3	-84.8	1.3879	0.8982	102	-5.5 -8	162.5, 164	-97	64.65	115.6	75	108 (cor), al	
32	Allyl acetate	104		1.40488	0.9276	100	16.6	118.2		97.1	82	153, 147	49.50	
33	Trimethyl orthoformate (Methyl orthoformate)	105, 102		1.3793	0.9676	106	8.4	100.7	-97	64.65	2.55	53	108 (cor), al	
34	Methyl isocrotonate	106.2, 108.2 (cor)				100	15	169	-97	64.65	101.2	132	108 (cor), al	
35	n-Butyl formate	106.6	-91.9	1.38940	0.8885	102	8.4	100.7	-90.2	117.6, 116	2.55	53	64, 62.5	
36	Ethyl isobutyrate	109.8, 111	-88.2	1.3903	0.86930	116	-46.1	154.7	-117.3	78.32	128, 129	108.5-9.5	93, al	Hydrazide, 104, eth -al
37	n-Propyl nitrate	110		1.3979	1.063	105				97.1			74, pet eth	
38	Chloromethyl acetate	111			1.094 <sup>15</sup>	108.5	16.6	118.2			82	153, 147		
39	Isopropyl propionate	111.3			0.8931 <sup>0</sup>	116	-20.8	141	-89.5	82.4	81, 81.3, 79	126, 123	123, pet eth	
40	sec-Butyl acetate	112.0		1.3865 <sup>25</sup>	0.872, 0.8648 <sup>25</sup>	116	16.6	118.2		99.5	82	153, 147	76	
41	n-Propyl chloroformate	113.115		1.40350	1.0901	122.5				97.1			74, pet eth	
42	Methyl isovalerate	116.7		1.3900 <sup>25</sup>	0.8808	116	-30.0	176.5	-97	64.65	135, 137	106.7	108 (cor), al	
43	Isobutyl acetate	117.2, 118		1.39008	0.8747	116	16.6	118.2		108.1	82	153, 147	87	
44	Ethyl pivalate (Ethyl trimethylacetate)	118.15		1.39061	0.85467	130	35.5	163-4	-117.3	78.32	155.7, 153-4, et ac - pet eth	119.20	93, al	
45	Ethyl methacrylate	118.5 <sup>11</sup>		1.41472	0.91063	114	16	161	-117.3	78.32	102.6		93, al	Polymerizes on heating, 4-Bromoanilide, 116

\*Derivative data given in order: m.p., crystal color, solvent from which crystallized.

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p-Tolu- dide	3,5-Di- nitro- benzoate	Miscellaneous	
						Equiv- alent	Acid		Alcohol					
							M P, °C	B P, °C	M P, °C					B P, °C
46	Methyl crotonate	118 8- 119 3			0 9806 <sup>4</sup>	100	72	189 (cor)	-97	64 65	118, w, 115	132, bz	108 (cor), al	
47	Isopropyl iso- butyrate	120 76			0 84708 <sup>21 3</sup>	130	-46 1	154 7		82 4	128, 129	108 5- 9 5	123, pet eth	Hydrazide, 104, eth -al
48	Ethyl n-butyrate	121 6	-100 8	1 40002	0 87917	116	-5 5, -8	162 5, 164	-117 3	78 32	115-6	75	93, al	
49	n-Propyl pro- pionate	122 2, 123 4	-75 9	1 39325	0 8809	116	-20 8	141		97 1	81, 81 3, 79	126 123	74, pet eth	
50	tert-Amyl acetate (Dimethylethyl- carbinyl acetate)	124		1 392	0 8738 <sup>19</sup>	130	16 6	118 2	-8 55	102 3	82	153, 147	116, 117-8	
51	Allyl propionate	124				114	-20 8	141		97 1	81, 81 3, 79	126 123	49 50	
52	Isoamyl formate	124 2	-93 5	1 39756	0 8820	116	8 4	100 7	-117	132	2 55	53	61	
53	Ethyl isocrotonate	125 5- 126 <sup>749</sup>		1 42423	0 91820	114	15	169	-117 3	78 32	101 2	132	93, al	
54	n-Butyl acetate	126 1	-73 5	1 39614	0 881	116	16 6	118 2	-90 2	117 6, 116	82	153, 147	64, 62 5	
55	Diethyl carbonate (Ethyl carbon- ate)	126 5	-43 0	1 3852	0 9752	118			-117 3	78 32			93, al	
56	tert-Butyl iso- butyrate	126 7		1 3921		144	-46 1	154 7	25 5	82 5	128, 129	108 5- 9 5	142, pet eth	Hydrazide, 104, eth -al
57	Methyl n-valerate (Methyl n- pentanoate)	127 7	-91 0	1 397	0 885	116	-34 5	186 35	-97	64 65	106	74	108 (cor), al	
58	Isopropyl n- butyrate	128			0 8652 <sup>13</sup>	130	-5 5, -8	162 5, 164	-89 5	82 4	115-6	75	123, pet eth	
59	Isobutyl chloro- formate	130, 128 8		1 40711 <sup>17 9</sup>		136 5				108 1			87	
60	Methyl methoxy- acetate	130		1 39636	1 0511	104		203	-97	64 65	96 5- 7 0, 92 4		108 (cor), al	
61	Methyl chloro- acetate	130, 132		1 4221	1 238	108 5	$\alpha$ 61 3, $\beta$ 56 2, $\gamma$ 52 5	189	-97	64 65	121	162	108 (cor), al	
62	Ethyl methoxy- acetate	132			1 0118 <sup>15</sup>	118		203	-117 3	78 32	96 5 7 0, 92-4		93, al	
63	n-Amyl formate	132 1, 130	-73 5	1 39916	0 8853	116	8 4	100 7	-78 5	138 (cor)	2 55	53	46 4	
64	sec-Amyl(3) acetate (Diethyl- carbinyl acetate)	133			1 4005	130	16 6	118 2		116 1	82	153, 147	101, 99, 97	
65	sec-Amyl(2) acetate (Methyl n-propylcarbinyl acetate)	133 5		1 3960	0 8692 <sup>18</sup>	130	16 6	118 2		119 85	82	153, 147	62	
66	Allyl isobutyrate	134				128	-46 1	154 7		97 1	128, 129	108 5 9 5	49-50	Hydrazide, 104, eth -al
67	Ethyl isovalerate	134 7	-99 3	1 4009	0 86565	130	-30 0	176 5	-117 3	78 32	135, 137	106-7	93, al	
68	n-Propyl iso- butyrate	135		1 3959	0 8843 <sup>0</sup>	130	-46 1	154 7		97 1	128, 129	108 5 9 5	74, pet eth	Hydrazide, 104, eth -al

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p-Tolu- dide	3,5-Di- nitro- benzoate	Miscellaneous	
						Equiv alent	Acid		Alcohol					
							M P, °C	B P °C	M P °C					B P °C
69	<i>n</i> -Butyl nitrate	136			1.048 <sup>o</sup>	119			-90.2	117.6 116			64, 62.5	
70	Methyl pyruvate	136.8 138, 134-7			1.154 <sup>o</sup>	102	13.6	165d	-97	64.65	124.5 145	109 130	108 (cor), al	2,4-Dinitro- phenylhyd- razone, 186.5-7.5 (cor), yel, diox-me al
71	Methyl $\alpha$ -hydroxyisobutyrate	137				118	79	212	-97	64.65		132.3, w	108 (cor), al	
72	Isobutyl propionate	138, 137	-71.4	1.3975	0.8876 <sup>o</sup>	130	-20.8	141		108.1	81, 81.3, 79	123-6	87	
73	Ethyl crotonate	138, 136.7 <sup>749</sup>		1.42524	0.91752	114	72, w	189 (cor)	-117.3	78.32	159.60, bz	132, bz	93, al	
74	Allyl <i>n</i> -butyrate	142				128	-5.5 -8	162.5, 164		97.1	115-6	75	49.50	
75	Isoamyl acetate (3-Methylbutyl acetate)	142		1.40034	0.8674	130	16.6	118.2	-117	132		153, 147	61	
76	Isopropyl isovalerate	142		1.3938 <sup>25</sup>	0.8538 <sup>17</sup>	144	-30	176.5	-89.5	82.4	135.137	106.7	123, pet eth	
77	<i>n</i> -Propyl <i>n</i> -butyrate	143.8	-95.2	1.4005	0.872	130	-5.5 -8	162.5 164		97.1	115.6	75	74, pet eth	
78	$\beta$ -Methoxyethyl acetate (Ethylene glycol mono-methyl ether acetate, Methyl cellosolve acetate)	144			1.088	118	16.6	118.2		124.5		153 147		
79	Methyl bromoacetate	144d			1.657	153	50	208	-97	64.65	91		108 (cor), al	
80	<i>n</i> -Butyl chloroformate	145, 139		1.417 <sup>14</sup>	1.079	136.5			-90.2	117.6, 116			64, 62.5	
81	$\beta$ -Chloroethyl acetate	145		1.4234	1.178	122.5	16.6	118.2		131	82	153, 147		
82	Methyl <i>d</i> -lactate	145 144.8		1.4144	1.0931	104	16.8, 18	122 <sup>15</sup>	-97	64.65	78.5-9.0 (cor), bz-al (3.1)	107	108 (cor), al	
83	Ethyl chloroacetate	145	-26	1.42274	1.158	122.5	$\alpha$ 61.3, $\beta$ 56.2, $\gamma$ 52.5	189	-117.3	78.32	121	162	93, al	
84	<i>tert</i> -Butyl <i>n</i> -butyrate	145-6.6		1.4001 <sup>17.5</sup>		144	-5.5, -8	162.5, 164	25.5	82.5	115-6	75	142, pet eth	
85	Triethyl orthoformate (Ethyl-orthoformate)	145.5		1.3922	0.8909	148	8.4	100.7	-117.3	78.32	2.55	53	93, al	
86	Ethyl <i>n</i> -valerate (Ethyl <i>n</i> -pentanoate)	145.5	-91.2	1.40094	0.8739	130	-34.5	186.35	-117.3	78.32	106	74	93, al	
87	Ethyl $\alpha$ -chloropropionate	146			1.087	136.5		186	-117.3	78.32	80	124	93, al	Phenylhydra- zide, 95

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p-Tolu- dide	3,5-Di- nitro- benzoate	Miscellaneous	
						Equiv- alent	Acid		Alcohol					
							M P °C	B P °C	M P °C					B P °C
88	<i>n</i> -Butyl propionate	146.8	-89.6	1.4038 <sup>15</sup>	1.401	130	-20.8	141	-90.2	117.6, 116	81, 81.3, 79	126, 123	64, 62.5	
89	Benzyl chloroacetate	147		1.5246 <sup>18</sup>	1.2223 <sup>1</sup>	170.5	α 61.3, β 56.2 γ 52.5	189	-15.3	205.5	121	162	113	
90	Di-isopropyl carbonate (Isopropyl carbonate)	147.2 (cor)		1.3932	0.9162	146			-89.5	82.4			123, pet eth	
91	Methyl isobutylcarbinyl acetate	148			0.8805 <sup>0</sup>	130	16.6	118.2	-97	64.65	82	153, 147	108 (cor), al	
92	Methyl ethoxyacetate	148			1.0112 <sup>1</sup>	118		206.7	-97	64.65	80.2	32, eth	108 (cor), al	
93	Isobutyl isobutyrate	148.6	-80.65	1.3999	0.87496 <sup>0</sup>	144	-46.1	154.7		108.1	128, 129	108.5, 9.5	87	Hydrazide, 104, eth-al
94	<i>n</i> -Amyl acetate ( <i>n</i> -Pentyl acetate)	149.25	-70.8	1.4031	0.8756	130	16.6	118.2	-78.5	138 (cor)	82	153, 147	46.4	
95	Ethyl α-hydroxyisobutyrate	150				132	79	212	-117.3	78.32		132.3, w	93, al	
96	Methyl glycolate	151.2			1.1677 <sup>18</sup>	90	78.9, 80		-97	64.65	120 al- et ac	143, w	108 (cor), al	
97	Methyl <i>n</i> -caproate (Methyl <i>n</i> -hexanoate)	151.25	-71.0	1.405	0.88464	130	-3.9	205.35	-97	64.65	100.1	74.5	123, pet eth	
98	Isopropyl <i>n</i> -valerate (Isopropyl <i>n</i> -pentanoate)	153.5		1.4009	0.8579	144	-34.5	186.35	-89.5	82.4	106	74	61	
99	Isoamyl chloroformate	154		1.41916 <sup>16</sup>	1.032 <sup>15</sup>	150.5			-117	132			93, al	
100	Ethyl <i>d,l</i> -lactate	154.5		1.410	1.030	118	16.8, 18	122 <sup>15</sup>	-117.3	78.32	78.5, 9.0 (cor), bz-al, (3.1)	107	93, al	
101	Ethyl pyruvate	155		0.0596 <sup>15, 6</sup>	1.408 <sup>15, 6</sup>	116	13.6	165d	-117.3	78.32	124.5, 145	109, 130	93, al	Phenylhydrazones, 118, dil al 4-Nitrophenylhydrazones, 185-7, 2,4-Dinitrophenylhydrazones, 154.5, 155 (cor), diox-al
102	<i>n</i> -Propyl isovalerate	155.5		1.40413 <sup>17, 8</sup>	0.8643 <sup>17, 8</sup>	144	-30	176.5		97.1	135, 137	106-7	74, pet eth	
103	<i>n</i> -Hexyl formate	155.51	-62.65	1.40898 <sup>15</sup> He (yel)	0.88133	130	8.4	100.7	-51.6 -46.1	157.5	2.55	53	58.4 (cor)	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p-Toluidide	3,5-Dinitrobenzoate	Miscellaneous	
						Equivalent	Acid		Alcohol					
							M P °C	B P °C	M P °C					B P °C
104	<i>β</i> -Ethoxyethyl acetate (Ethylene glycol monoethyl ether acetate, Ethyl cellosolve acetate)	156.2, 158		1.40292	0.9701	132	16.6	118.2		135	82	153, 147	75, al	
105	Isobutyl <i>n</i> -butyrate	157		1.40295 <sup>14,4</sup>	0.8620	144	-5.5 -8	162.5 164		108.1	115.6	75	87	
106	Ethyl dichloroacetate	158		1.43860	1.2821	157	5.6	194	-117.3	78.32	98 (subl)	153	93, al	
107	Ethyl bromoacetate	159		1.451	1.506	167	50	208	-117.3	78.32	91		93, al	
108	Ethyl glycolate	160			1.0869 <sup>15</sup>	104	78.9 80		-117.3	78.32	120, al - et ac	143, w	93, al	
109	Isoamyl propionate	160.2		1.4065	0.870	144	-20.8	141	-117	132	81, 81.3 79	126 123	61	
110	Ethyl $\alpha$ -bromopropionate	162			1.524	181	25.7	203.5	-117.3	78.32	123	125	93, al	
111	Cyclohexyl formate	162.5 <sup>750</sup>		1.443	1.010	128	8.4	100.7	25.1	161.1	2.55	53	112-3, al	
112	<i>β</i> -Bromoethyl acetate	163			1.524	167	16.6	118.2		149d	82	153, 147		
113	Tetraethyl silicate (Ethyl orthosilicate)	165.5, 168.5		1.38619	0.93975	52			-117.3	78.32			93, al	Gives SiO <sub>2</sub> on hydrolysis
114	<i>n</i> -Propyl <i>n</i> -valerate ( <i>n</i> -Propyl <i>n</i> -pentanoate)	166.2, 167	-70.7	1.4065	0.8699	144	-34.5	186.35		97.1	106	74	74, pet eth	
115	<i>n</i> -Butyl <i>n</i> -butyrate	166.6	-91.5	1.406	0.869	144	-5.5 -8	162.5, 164	-90.2	117.6 116	115.6	75	64, 62.5	
116	Ethyl <i>n</i> -caproate (Ethyl <i>n</i> -hexanoate)	167.7	-67.5	1.40727	0.8710	144	-3.9	205.35	-117.3	78.32	100.1	74.5	93, al	
117	Ethyl trichloroacetate	168		1.450	1.380	191.5	57.8	197.5	-117.3	78.32	141	113	93, al	Phenylhydrazide, 123
118	Isopropyl <i>d,l</i> -lactate	168, 166.8		1.4082 <sup>25</sup>	0.998	132	16.8, 18	122 <sup>15</sup>	-89.5	82.4	78.5, 90 (cor), bz-al (3.1)	107	123, pet eth	
119	Di- <i>n</i> -propyl carbonate ( <i>n</i> -Propyl carbonate)	168.5 (cor)		1.4014	0.9411	146				97.1			74, pet eth	
120	<i>n</i> -Amyl propionate ( <i>n</i> -Pentyl propionate)	168.7	-73.1	1.4096 <sup>15</sup>	0.8761 <sup>15</sup>	144	-20.8	141	-78.5	138 (cor)	81, 81.3, 79	126, 123	46.4	
121	Ethylidene diacetate	169			1.061 <sup>12</sup>	73	16.6	118.2	-12.6	197.85	82	153, 147	169	
122	Isoamyl isobutyrate	169			0.8760 <sup>0</sup>	158	-46.1	154.7	-117	132	128, 129	108.5- 9.5	61	Hydrazide, 104, eth-al
123	Methyl acetoacetate	170		1.41964	1.0765 <sup>0</sup>	116			-97	64.65			108 (cor), al	Semicarbazone, 152.5, me al
124	Isobutyl isovalerate	171		1.40569	0.8534	158	-30	176.5		108.1	135, 137	106.7	87	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. I) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p-Toluidide	3,5-Dinitrobenzoate	Miscellaneous	
						Equivalent	Acid		Alcohol					
							M P, °C	B P, °C	M P, °C					B P, °C
125	Methyl enanthate (Methyl <i>n</i> -heptanoate)	173.8	-55.8	1.412	0.88011	144	-74.7	223	-97	64.65	96.965	81	108 (cor), al	
126	Ethylene glycol diformate	174			1.193 <sup>0</sup>	59	8.4	100.7	-78.5	138 (cor)	2.55	53	46.4	
127	sec-Butyl <i>n</i> -valerate (sec-Butyl <i>n</i> -pentanoate)	174.5		1.4081	0.8605 <sup>20</sup>	158	-34.5	108.35		99.5	106	74	76	
128	Cyclohexyl acetate	175		1.442	0.970	142	16.6	118.2	25.1	161.1	82	153, 147	112.3, al	
129	<i>n</i> -Butyl chloroacetate	175		1.081	1.081	150.5	α 61.3, β 56.2, γ 52.5	189	-90.2	117.6, 116	121	162	64, 62.5	
130	Furfuryl acetate	175.7		1.4627	1.118	140	16.6	118.2		172, 170	82	153, 147	80.1	
131	Methyl methylacetoacetate	177.4		1.418	1.030	130			-97	64.65			108 (cor), al	Semicarbazone, 138, al
132	<i>n</i> -Heptyl formate	178.12		1.41505 <sup>15</sup> He (yel)	0.87841	144	8.4	100.7	-34.6, -33.8	176.8	2.55	53	46.47	
133	<i>n</i> -Hexyl acetate	178.1	-80.9, -60.9	1.41122 <sup>15</sup> He (yel)	0.87336	144	16.6	118.2	-51.6, -46.1	157.5	82	153, 147	58.4 (cor)	
134	Isoamyl <i>n</i> -butyrate	178.6		1.411	0.864	158	-5.5, -8	162.5, 164	-117	132	115.6	75	61	
135	Ethyl β-bromopropionate	179		1.425	1.425	181	62.5		-117.3	78.32	111		93, al	2-Naphthylamide, 174
136	Ethyl acetyl-glycolate	179		1.0993 <sup>17</sup>	1.0993 <sup>17</sup>	73			-117.3	78.32			93, al	Hydrolysis → glycolic a + ac a + al
137	Isobutyl <i>n</i> -valerate (Isobutyl <i>n</i> -pentanoate)	179		1.4099	0.8625	158	-34.5	186.35		108.1	106	74	87	
138	β-Hydroxyethyl formate (Ethylene glycol monoformate)	180		1.1989 <sup>15</sup>	1.1989 <sup>15</sup>	90	8.4	100.7	-78.5	138 (cor)	2.55	53	46.4	
139	Ethyl methylacetoacetate	180.8 (cor), 187		1.419	1.0191	144			-117.3	78.32	73, eth		93, al	Anilide, 138-40, Semicarbazone, 194, 2,4-Dinitrophenyl hydrazone, 56-7
140	Ethyl acetoacetate	181		1.41976	1.025	130			-117.3	78.32			93, al	Semicarbazone, 129, 133, eth
141	Methyl pyromucate (Methyl 2-furoate)	181.3		1.4860	1.180	126	133.4, 132	230-2	-97	64.65	142-3	170.5, al	108 (cor), al	2,4-Dinitrophenylhydrazone, 93, 96, yel, al

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p-Tolu- dide	3,5 Di- nitro benzoate	Miscellaneous	
						Equiv alent	Acid		Alcohol					
							M P °C	B P °C	M P °C					B P °C
142	Dimethyl malonate (Methyl malonate)	181.5	-62	1.41398	1.1539	66	134.8	9	-97	64.65	mono 106 110 di- 170 w-al	mono 156d 252 3, al	108 (cor) al	Phenylhydrazide, 194
143	Ethyl β-methoxyethyl carbonate	182.6		1.4036 <sup>45</sup>	1.0424 <sup>45</sup>	148			-117.3	78.32			93 al	
144	Methyl cyclohexanecarboxylate (Methyl hexahydrobenzoate)	183		1.45372 <sup>15</sup>	0.9954 <sup>15</sup>	142	30.1	233	-97	64.65	185.6		108 (cor), al	
145	Diethyl oxalate (Ethyl oxalate)	185.19	-41.5, -40.6	1.41043	1.0785	73	189.5 (anh) 101 (+ 2H <sub>2</sub> O)		-117.3	78.32	mono 219 di 419d	mono 169 di 268	93, al	N-(β-Aminoethyl)-morpho- lide 170
146	n-Amyl n-butyrate (n-Pentyl n-butyrate)	186.4	-72.3	1.412	0.866	158	-5.5, -8	162.5 164	-78.5	138 (cor)	115-6	75	46.4	
147	n-Butyl n-valerate (n-Butyl n-pentanoate)	186.9	-92.8	1.4123	0.8678	158	-34.5	186.35	-90.2	117.6 116	106	74	64 62.5	
148	β-Hydroxyethyl acetate (Ethylene glycol monoacetate)	187-9				104	16.6	118.2	-78.5	138 (cor)	82	153 147	46.4	
149	n-Propyl n-caproate (n-Propyl n-hexanoate)	187.15 186	-74.0	1.417	0.86719	158	-3.9	205.35		97.1	100.1	74.5	74, pet eth	
150	Dimethyl sulfate (Methyl sulfate)	188	-27	1.3874	1.3348 <sup>15</sup>	63			-97	64.65			108 (cor), al	
151	n-Butyl lactate	188	-43	1.4216	0.984 <sup>20</sup> <sub>20</sub>	146	16.8, 18	122 <sup>15</sup>	-90.2	117.6 116	78.5-9.0 (cor), bz-al (3.1)	107	64 62.5	
152	Ethyl enanthate (Ethyl n-heptanoate)	188.6	-66.3	1.413	0.86856	158	-7.47	223	-117.3	78.32	96, 96.5	81	93, al	
153	Methyl ethylacetate (cor)	189.7			0.989	144			-97	64.65	95.6, bz		108 (cor), al	
154	Di-isobutyl carbonate (Isobutyl carbonate)	189.8		1.4072	0.9138	174				108.1			87	
155	n-Hexyl propionate	190	-57.5	1.41621 <sup>15</sup> He (yel)	0.86980	158	-20.8	141	-51.6 -46.1	157.5	81, 81.3, 79	126 123	58.4 (cor)	
156	Ethylene glycol diacetate	190.2	-31	1.4150	1.1040	73	16.6	118.2	-78.5	138 (cor)	82	153, 147	46.4	
157	Isoamyl iso-valerate	190.4		1.41300 <sup>18.7</sup>	0.870	172	-30	176.5	-117	132	135, 137	106.7	61	
158	n-Heptyl acetate	192.45		1.41653 <sup>15</sup> He (yel)	0.87070 <sup>15</sup>	158	16.6	118.2	-34.6, -33.8	176.8	82	153, 147	46, 47	
159	Cyclohexyl propionate	193 <sup>750</sup>			0.9718 <sup>0</sup>	156	-20.8	141	25.1	161.1	81, 81.3, 79	126, 123	112.3, al	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p-Tolu- dide	3,5-Di- nitro- benzoate	Miscellaneous	
						Equiv alent	Acid		Alcohol					
							M P, °C	B P, °C	M P, °C					B P, °C
160	Di-isopropyl oxalate (Iso-propyl oxalate)	193.4		1.4100	1.0097	87	189.5 (anh), 101 (+ 2H <sub>2</sub> O)		-89.5	82.4	mono 219, di 419d	mono 169, di 268	123, pet eth	
161	Ethyl β-ethoxyethyl carbonate	194.5		1.5064 <sup>25</sup>	1.0115 <sup>25</sup>	162			-117.3	78.32			93, al	
162	sec-Octyl acetate	194.5		1.4141	0.8606 <sup>19</sup>	172	16.6	118.2		179	82	153, 147	32	
163	Methyl n-caprylate (Methyl n-octanoate)	194.6	-41	1.417	0.878	158	16.3	237, 239.3	-97	64.65	57	70	108 (cor), al	
164	α-Tetrahydrofurfuryl acetate	195, 194		1.4350	1.0624 <sup>25</sup>	144	16.6	118.2		177-8 <sup>743</sup>	82	153, 147	83-4	
165	Methyl levulinate	196, 191		1.42333	1.04945	130	33.5	245-6	-97	64.65	107-8, al	108.9, w	108 (cor), al	Semicarbazone, 142-3, Phenylhydrazone, 94-6, 2,4-Dinitrophenylhydrazone, 141.5-2.5 (cor), diox-al, Oxime, 96
166	Ethyl cyclohexanecarboxylate (Ethyl hexahydrobenzoate)	196		1.45012 <sup>15</sup>	0.9672 <sup>15</sup>	156	30.1	233	-117.3	78.32	185.6		93, al	
167	Diethyl methylmalonate	196			1.019 <sup>15</sup>	87	137, 138d		-117.3	78.32	217, 206	mono 145d, di 228, 214	93, al	
168	Phenyl acetate	196.7		1.503	1.078	136	16.6	118.2	41.8, 42	182	82	153, 147	145.8 (cor), al	
169	Ethyl ethylacetoacetate	198		1.422	0.9856	158			-117.3	78.32	95.6, bz		93, al	Ketone cleavage → 2-pentanone, b p 102
170	n-Octyl formate	198.8	-39.1	1.42082 <sup>15</sup>	0.87435	158	8.4	100.7	-16, -16.7	195	2.55	53	61-2	
171	2-Ethyl-1-hexyl acetate	199			0.8733 <sup>30</sup>	172	16.6	118.2		184.6	82	153, 147		
172	Methyl benzoate	199.2	-12.4	1.5164	1.0888	136	122.4	249	-97	64.65	130	158	108 (cor), al	
173	Diethyl malonate (Ethyl malonate) ...	199.3	-51.5	1.41618	1.05513	80	134.8.9		-117.3	78.32	mono 106, di 170, w-al	mono 156d, di 252-3, al	93, al	Phenylhydrazone, 194
174	Methyl cyanoacetate	200	-22.5		1.0962 <sup>25</sup>	99	66		-97	64.65	119.20		108 (cor), al	

\* Derivative data given in order m p, crystal color, solvent from which crystallized



TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p-Toluide	3,5-Dinitrobenzoate	Miscellaneous	
						Equiv. valent	Acid		Alcohol					
							M P, °C	B P, °C	M P, °C					B P, °C
175	Dimethyl mesaconate	203		1.45119	1.0914	79	204.5 (cor)		-97	64.65	mono (α) 222 (β) 174, di 176.5	mono (α) 196, di 212, al	108 (cor), al	Dihydrazide, 215d, dil al
176	Benzyl formate	203		1.516	1.080	136	8.4	100.7	-15.3	205.5	2.55	53	113	
177	Vinyl benzoate	203		1.065	1.065	148	122.4	249			130	158		
178	Cyclohexyl isobutyrate	204 <sup>750</sup>		0.9489 <sup>0</sup>		170	-46.1	154.7	25.1	161.1	128.129	108.5	112-3, al	Hydrazide, 104, al-eth
179	Dimethyl maleate	204.4	7.6	1.44156	1.14513 <sup>15</sup>	72	137		-97	64.65	mono 172.3, w, 153, sl d, di 181, me al	di, 142, eth	108 (cor), al	
180	α-Tetrahydrofurfuryl propionate	204-7			1.044	158	-20.8	141		177.8 <sup>743</sup>	81, 81.3, 79	126, 123	83.4	
181	Ethyl levulinate	205.8		1.42288	1.01114	144	33.5	245-6	-117.3	78.32	107-8d	108-9, w	93, al	Semicarbazone, 147.8, Phenylhydrazide, 103-4, 2,4-Dinitrophenylhydrazide, 101.2, diox-al, Oxime, 96
182	Ethyl allylacetoacetate	206 sl d, 211-2 sl d		1.43 <sup>17.6</sup>	0.9898	170			-117.3	78.32			93, al	Semicarbazone, 125, w
183	n-Amyl n-valerate (n-Pentyl n-pentanoate)	207.4		1.4181 <sup>15</sup>	0.8825 <sup>0</sup>	172	-34.5	186.35	-78.5	138 (cor)	106	74	46.4	
184	Di-n-butyl carbonate (n-Butyl carbonate)	207.5 (cor)		1.4117	0.9238	174			-90.2	117.6, 116			64, 62.5	
185	n-Butyl n-caproate (n-Butyl n-hexanoate)	207.74	-63.1, -64.3	1.41877 <sup>15</sup> He (yel)	0.86530	172	-3.9	205.35	-90.2	117.6, 116	100-1	74.5	64, 62.5	
186	n-Hexyl n-butyrate	207.88	-78	1.41875 <sup>15</sup> He (yel)	0.86519	172	-5.5, -8	162.5, 164	-51.6, -46.1	157.5	115-6	75	58.4 (cor)	
187	2-Tolyl acetate ("o-Cresyl acetate")	208			1.048	150	16.6	118.2	31	191.2	82	153, 147	134.8 (cor), al	
188	Diethyl sulfate (Ethyl sulfate)	208		1.4010 <sup>18</sup>	1.172 <sup>25</sup>	77			-117.3	78.32			93, al	
189	n-Propyl n-enanthate (n-Propyl n-heptanoate)	208	-64.8	1.41835 <sup>15</sup>	0.86556	172	-7.47	223		97.1	96, 96.5	81	74, pet eth	
190	Ethyl n-caprylate (Ethyl n-octanoate)	208.35	α -43.1, β -59.2	1.41775	0.8667	172	16.3	237, 239.3	-117.3	78.32	110, 106	70	93, al	N-(β-Aminoethyl) morpholide, 59

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XVI. ORGANIC DERIVATIVES OF ESTERS**

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p-Toluide	3,5-Dinitrobenzoate	Miscellaneous	
						Equiv- alent	Acid		Alcohol					
							M P, °C	B P, °C	M P °C					B P °C
191	Isobutyl enanthate (Isobutyl <i>n</i> -heptanoate)	209			0.8593	186	-7.47	223		108.1	96.96.5	81	87	
192	Isopropyl levulinate	209.3		1.42088	0.98724	158	33.5	245.6		82.4	107.8d	108-9, w	123, pet eth	Semicarbazone, 141-2, Phenylhydrazone, 108.9, 2,4-Dinitrophenylhydrazone, 88-9 (cor.), 90.9
193	Trimethylene glycol diacetate (1,3-Diacetoxypropane)	210			1.069	80	16.6	118.2	-30	214.7 210.2	82	153 147	178	
194	<i>n</i> -Octyl acetate	210			0.8847 <sup>o</sup>	172	16.6	118.2	-16 -16.7	195	82	153 147	61.2	
195	<i>n</i> -Heptyl propionate	210	-50.9	1.42605 <sup>17</sup> He (yel)	0.86786	172	-20.8	141	-34.6 -33.8	176.8	81.81.3 79	126 123	46.47	
196	Dimethyl citraconate	210.5		1.44856	1.11531	79	92.91d eth lgr	206 11, sl d	-97	64.65	100.1		108 (cor.), al	Dihydrazide, 177, w, 1-Naphthylamide, 169-70
197	<i>n</i> -Propyl pyromucate ( <i>n</i> -Propyl 2-furoate)	211		1.4737 <sup>25.9</sup>	1.0745 <sup>25.9</sup>	154	133-4, 132	230.2		97.1	142.3	170.5, al	74, pet eth	
198	Ethylene glycol dipropionate	211			1.0544 <sup>15</sup>	87	-20.8	141	-78.5	138 (cor) 79	81, 81.3, 126 123	126 123	46.4	
199	Cyclohexyl <i>n</i> -butyrate	212 <sup>750</sup>			0.9572 <sup>o</sup>	170	-5.5, -8	162.5, 164	25.1	161.1	115.6	75	112-3, al	
200	3-Tolyl acetate ("m-Cresyl acetate")	212	12	1.4978	1.049	150	16.6	118.2	11.95	202.7	82	153, 147	164.5 (cor.), al	
201	Ethyl aceto-pyruvate	213.5		1.4757 <sup>17</sup>	1.1251	158	101, bz		-117.3	78.32	131.2d, al		93, al	
202	Ethyl benzoate	212.4 213.2	-34.7	1.50570	1.04684	150	122.4	249	-117.3	78.32	130	158	93, al	N-(β-Aminoethyl) morpholide, 123.4
203	4-Tolyl acetate ("p-Cresyl acetate")	212.5		1.500	1.051	150	16.6	118.2	36	202	82	153 147	188.6 (cor.), al	
204	Di- <i>n</i> -propyl oxalate ( <i>n</i> -Propyl oxalate)	213.9	-51.7	1.4168	1.0169	87	189.5 (anh), 101 (+2 H <sub>2</sub> O)			97.1	mono 219, di 419d	mono 169, di 268	74, pet eth	NH <sub>2</sub> OH → Di- <i>n</i> -propyl oxamate, 90-2, me al
205	Methyl pelargonate	214, 213-4			0.892	172	12.3	254.4	-97	64.65	99	84	108 (cor.), al	
206	Dimethyl glutarate	214 <sup>751</sup>	-34.7	1.42415	1.0874	80	98	302.4	-97	64.65	di 175	di 218	108 (cor.), al	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p-Tolu- l-ide	3,5-Di- nitro- benzoate	Miscellaneous	
						Equiv alent	Acid		Alcohol					
							M P., °C	B P., °C	M P., °C					B P., °C
207	2,6-Dimethyl-phenyl acetate (vic-m-Xylenyl acetate)	214-6				164	16 6	118 2	49	203	82	153, 147	158 8 (cor), al	
208	Methyl 2-toluate (Methyl 2-methylbenzoate)	215			1 068	150	104-5, 107 8	259 <sup>751</sup>	-97	64 65	142 8 (cor)	144	108 (cor), al	
209	Benzyl acetate	217		1 5200	1 055	150	16 6	118 2	-15 3	205 5	82	153, 147	113	N-(β-Aminoethyl) morpholide, 95 2
210	Diethyl succinate	217 25	-20 8	1 41975	1 0398	87	185 182 8	235d	-117 3	78 32	mono 157, di 260d, w	mono 179 80, di 254 5-5 5, 260	93, al	N-(β-Aminoethyl) morpholide, 174
211	Diethylene glycol monoethyl ether acetate	218			1 013	176	16 6	118 2		198	82	153, 147	oil	
212	Diethyl fumarate	218 4, 213-4	0 55	1 44103	1 052	86	286 7 (sealed tube), 233-5, 200, subl		-117 3	78 32	mono 270, 300-2, subl, di 266d	mono 233 0-4 5, di 313 4, ac a	93, al	
213	Isopropyl benzoate	218 5		1 4890 <sup>25</sup>	1 013	164	122 4	249	-89 5	82 4	130	158	123, pet eth 108 (cor), al	
214	Methyl phenylacetate	220		1 507	1 068	150	76 5, subl	256 5 (cor)	-97	64 65	156	135-6	108 (cor), al	
215	l-Linalyl acetate	220		1 4460	0 8951	196	16 6	118 2		199	82	153, 147		[α] <sub>D</sub> -3 to -17, 4-Nitrobenzoate, 70
216	Methyl 3-toluate (Methyl 3-methylbenzoate)	221, 215			1 061	150	111 3, 110-1	263, subl	-97	64 65	94, 97	118	108 (cor), al	
217	n-Propyl levulinate	221 2		1 42576	0 98955	158	33-5	245 6		97 1	107-8d	108-9, w	74, pet eth	Semicarbazone, 129-30, Hydrazone, 88-90, Phenylhydrazone, 67-8 (cor), al, Oxime, 96
218	Diethyl d,l-tartrate	222-5d			1 152 <sup>15</sup>	88	156-8d		-117 3	78 32	di 198, dil al, 195-6d		93, al	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS  
Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p Toluide	3,5-Di nitro benzoate	Miscellaneous	
						Equiv alent	Acid		Alcohol					
							M P °C	B P °C	M P °C					B P °C
219	Diethyl maleate	222.7	-17	1.44156	1.066	86	137		-117.3	78.32	mono 172.3, w 152.3 sl d di 181, me al	di 142, eth	93, al	
220	Methyl salicylate	224		1.5369	1.184	152	158.3		-97	64.65	142, 139	156	108 (cor), al	
221	Ethyl <i>n</i> -butoxyethyl carbonate	224		1.4143 <sup>2</sup>	0.9756 <sup>25</sup>	190			-117.3	78.32			93, al	
222	sec-Butyl levulinat	225.8		1.42495	0.96698	172	33.5	245.6		99.5	107.8d	108.9, w 75	76	Oxime, 96
223	<i>n</i> -Heptyl <i>n</i> -butyrate	225.87	-57.5	1.42279 <sup>15</sup> He (yel)	0.86371	186	-5.5 -8	162.5, 164	34.6 -33.8	176.8	115.6	75	46.47	
224	2,4-Dimethylphenyl acetate (unsym- <i>m</i> -Xylenyl acetate)	226 (cor)		1.4990 <sup>15</sup>	1.0298 <sup>15, 5</sup>	164	16.6	118.2	27	211.5 (cor)	82	153, 147	164.6 (cor), 95°, al	
225	Methyl <i>n</i> -caprate (Methyl <i>n</i> -decanoate)	226		1.426	0.873	186	31.5	268.70	-97	64.65	108, 100.1	78	108 (cor), al	
226	<i>n</i> -Amyl <i>n</i> -caproate ( <i>n</i> -Pentyl <i>n</i> -hexanoate)	226.16	-50, -47	1.42280 <sup>15</sup> He (yel)	0.86349	186	-3.9	205.35	-78.5	138 (cor)	100.1	74.5	46.4	
227	<i>n</i> -Butyl <i>n</i> -enanthate ( <i>n</i> -Butyl <i>n</i> -heptanoate)	226.2		1.42280 <sup>15</sup>	0.86382	186	-7.47	223	-90.2	117.6, 116	96.96.5	81	64, 62.5	
228	<i>n</i> -Hexyl <i>n</i> -valerate ( <i>n</i> -Hexyl <i>n</i> -pentanoate)	226.3	-63.1	1.42286 <sup>15</sup>	0.86345	186	-34.5	186.35	-51.6 -46.1	157.5	106	74	58.4 (cor)	
229	<i>n</i> -Propyl <i>n</i> -caprylate ( <i>n</i> -Propyl <i>n</i> -octanoate)	226.43	-46.2	1.42351 <sup>15</sup> He (yel)	0.86591	186	16.3	237 239.3		97.1	110.106	57	74, pet eth	
230	Ethyl 2-toluate (Ethyl 2-methyl benzoate)	227		1.507 <sup>21, 6</sup>	1.0325 <sup>21, 5</sup>	164	104-5, 107.8	259 <sup>25, 1</sup>	-117.3	78.32	142.8 (cor)	144	93, al	
231	Ethyl pelargonate	227	α -55.0, β -36.7	1.42200	0.8657	186	12.3	254.4	-117.3	78.32	99	84	93, al	N-(β-Aminoethyl) morpholide, 61.3
232	<i>l</i> -Menthyl acetate	227			0.9185	198	16.6	118.2	43	216	82	153, 147	153	
233	Ethyl phenylacetate	227.5		1.49921 <sup>18, 5</sup>	1.0333	164	76.5, subl	256.5 (cor)	-117.3	78.32	156	135-6	93, al	N-(β-Aminoethyl) morpholide, 88.9
234	<i>n</i> -Octyl propionate	227.9	-41.6	1.42185 <sup>17</sup> He (yel)	0.86633	186	-20.8	141	-16, -16.7	195	81, 81.3, 79	126, 123	61-2	
235	Diethyl itaconate	228		1.4377	1.0467	93	165		-117.3	78.32	di 191.2-8, al		93, al	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p-Tolu- dide	3,5-Di- nitro- benzoate	Miscellaneous	
						Equiv- alent	Acid		Alcohol					
							M P, °C	B P, °C	M P, °C					B P, °C
236	Diethyl mesa- conate	229		1.4488	1.0453	93	204.5 (cor), subl		-117.3	78.32	mono (α) 222 (β) 174 di 176.5	mono (α) 196 di 212, al	93, al	
237	Di-isobutyl oxalate (Isobutyl oxalate)	229		1.4180	0.97373	101	189.5 (anh), 101 (+2 H <sub>2</sub> O)			108.1	mono 219 di 419d	mono 169 di 268	87	
238	Allyl benzoate	230		1.067 <sub>1</sub>	1.0578 <sub>1</sub>	162	122.4	249		97.1	130	158	49, 50	
239	Isobutyl levulinate	230.9		1.42677	0.96770	172	33.5	245.6		108.1	107.8d	108.9, w	87	Semicarba- zone, 112.3, Phenylhyd- razone, 84.6, 2,4-Dinitro- phenylhyd- drazone, 55.6, Oxime, 96
240	n-Propyl benzoate	231		1.500	1.023	164	122.4	249		97.1	130	158	74, pet eth	
241	Diethyl citra- conate	231		1.4442	1.0491	93	92d, eth lgr	206.11 sl d	-117.3	78.32	100.1		93, al	1-Naphthyl- amide, 169- 70
242	Methyl 3-chloro- benzoate	231				170.5	158, 155		-97	64.65	134		108 (cor), al	
243	β-Phenylethyl acetate	232, 224		1.5108	1.057 <sup>22.5</sup>	164	16.6	118.2	-25.8	219.8	82	153 147	108	
244	Ethyl β-(2-furyl) acrylate	232	14	1.5286	1.0891 <sup>15</sup>	166	141	286	-117.3	78.32	168.9, w		93, al	
245	Di-(β-methoxy- ethyl) carbonate	232		1.4193 <sup>20</sup>	1.0936 <sup>25</sup>	178				124.5				
246	Di-isoamyl car- bonate	233 (cor)		1.4174	0.9067	202			-117	132			61	
247	Diethyl glutarate	233.66	-23.8	1.02229	1.42395	94	98	302-4	-117.3	78.32	di 175-6	di 218	93, al	N-(β-Amino- ethyl) mor- pholide, 152.7
248	Ethyl 3-toluate	234		1.505 <sup>21.4</sup>	1.0265 <sup>21.4</sup>	164	111.3, 110.1	263, subl	-117.3	78.32	94, 97	118	93, al	
249	Ethyl salicylate	234		1.52542	1.1396	166	158.3, subl at 76		-117.3	78.32	142, 139	156	93, al	
250	Methyl 2-chloro- benzoate	234				170.5	142, 144		-97	64.65	142, 202	131	108, (cor), al	
251	Ethyl 4-toluate	234.5		1.5089 <sup>18.2</sup>	1.0269 <sup>18.2</sup>	164	179.80, subl	275 (cor)	-117.3	78.32	160, 158	160, 165	93, al	
252	Diethyl bromo- malonate	235		1.426 <sub>1</sub>		239	113d		-117.3	78.32	di 181, al	di 217, ac a	93, al	

\* Derivative data given in order: m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p-Toluide	3,5-Di-nitrobenzoate	Miscellaneous	
						Equivalent	Acid		Alcohol					
							M.P., °C	B.P., °C	M.P., °C					B.P., °C
253	Ethylene glycol di-n-butyrate	235-77 <sup>40</sup>		1.42619 <sup>He</sup>	1.0005	101	-5.5, -8	162.5, 164	-78.5	138 (cor)	115.6	75	46.4	
254	Diethyl butylmalonate	235-40			1.425	101			-117.3	78.32	di 200		93, al	
255	2,4,6-Trimethylphenyl acetate (Mesityl acetate)	236				178	16.6	118.2	70, 69	220	82	153, 147		
256	2,5-Dimethylphenyl acetate (p-Xylenyl acetate)	237 <sup>68</sup>			1.0264 <sup>15</sup>	164	16.6	118.2	74.5	212	82	153, 147	137.2 (cor), al	
257	n-Butyl levulinate	237.8		1.42905	0.97353	172	33.5	245-6	-90.2	117.6, 116	107.8d	108-9, w	64, 62.5	Semicarbazone, 102-3, Phenylhydrazone, 79.81, 2,4-Dinitrophenylhydrazone, 65.8, Oxime, 96
258	Benzyl n-butyrate	238-40			1.033 <sup>10</sup>	178	-5.5, -8	162.5, 164	-15.3	205.5	115-6	75	113	
259	Methyl hydrocinnamate (Methyl β-phenylpropionate)	239			1.0455 <sup>9</sup>	164	48.7, 40	279-80 (cor)	-97	64.65	105, 82	135	108 (cor), al	
260	n-Propyl salicylate	239, 249-51		1.51610	1.0979	180	158.3			97.1	142, 139	156	74, pet eth	
261	Guaiacol acetate (2-Methoxyphenyl acetate)	240		1.5101 <sup>25</sup>	1.1285 <sup>25</sup>	166	16.6	118.2	32, 28.2	205	82	153, 147	141.2 (cor), al	
262	Isopropyl salicylate	240-2, 237		1.50650	1.0729	180	158.3, subl at 76		-89.5	82.4	142, 139	156	123, pet eth	
263	Dimethyl l-malate	242		1.4425	1.2334	81	100-1		-97	64.65	di 156-7	di 206-7	108 (cor), al	[α] <sub>D</sub> <sup>20</sup> -6.85
264	Geranyl acetate	242		1.4660	0.9174 <sup>15</sup>	196	16.6	118.2		230	82	153, 147	62-3	
265	Isobutyl benzoate	242.2 (cor)			0.999	178	122.4	249		108.1	130	158	87	
266	Di-n-butyl oxalate (n-Butyl oxalate)	243, 245.5	-29.6	1.4240	0.98732	101	189.5 (anh), 101 (+ 2H <sub>2</sub> O)		-90.2	117.6, 116	mono 219, di 419d	mono 169, di 268	64, 62.5	
267	Methyl 2-bromobenzoate	244				215	150		-97	64.65	155		108 (cor), al	
268	n-Octyl n-butyrate	244.1	-55.6	1.42674 <sup>15</sup> He (yel)	0.86288	200	-5.5, -8	162.5, 164	-16, -16.7	195	115.6	75	61.2	
269	Ethyl n-caprate (Ethyl n-decanoate)	244.9	β -20, γ -30.6	1.42575	0.8650	200	31.5	268.70	-117.3	78.32	108, 100.1		93, al	N-(β-Aminoethyl) morpholide, 60.1

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p-Toluene	3,5-Dinitrobenzoate	Miscellaneous	
						Equiv. valent	Acid		Alcohol					
							M.P. °C	B.P. °C	M.P. °C					B.P. °C
270	Diethyl adipate	245, 133.8 <sup>15</sup>	-21	1.42765	1.0090	101	153-4 (cor)	216 <sup>15</sup>	-117.3	78.32	mono 125, 30, w, di 220	241	93, al	N-(β-Aminoethyl)morpholide 165
271	Methyl phenoxyacetate	245		1.150 <sup>17, 18</sup>		166	98.9	285d	-97	64.65	101.5		108 (cor), al	
272	Thymyl acetate	245		1.009 <sup>9</sup>		192	16.6	118.2	51.5	233.5	82	153, 147	103.2 (cor), al	
273	Carvacryl acetate	245 (cor)		1.49128 <sup>28</sup>	0.98959 <sup>25</sup>	192	16.6	118.2	1	237.5	82	153, 147	83	
274	Diethylene glycol diacetate (β,β'-Diacetoxy diethyl ether)	245.51, 148 <sup>26</sup>		1.4348	1.1078 <sup>15</sup>	95	16.6	118.2	-10.45	244.5	82	153, 147	149 ac a	
275	n-Butyl n-caprylate (n-Butyl n-octanoate)	245.02	-41.9, -43	1.42647 <sup>17</sup>	0.86278	200	16.3	237	-90.2	117.6, 116	110, 106	70	64, 62.5	
276	n-Heptyl n-valerate (n-Heptyl n-pentanoate)	245.2	-46.4	1.42536 <sup>15</sup>	0.86225	200	-34.5	186.35	-34.6, -33.8	176.8	106	74	46.47	
277	n-Amyl n-enanthate (n-Pentyl n-heptanoate)	245.4	-49.5	1.42627 <sup>15</sup>	0.86232	200	-7.47	223	-78.5	138 (cor)	96, 96.5	81	46.4	
278	n-Hexyl n-caproate (n-Hexyl n-decanoate)	245.4	-55.25	1.42637 <sup>17</sup>	0.86216	200	-3.9	205.35	-51.6, -46.1	157.5	100.1	74.5	58.4 (cor)	
279	Di-(β-ethoxyethyl) carbonate	245.5		1.4239 <sup>25</sup>	1.0635 <sup>25</sup>	206				135			75, al	
280	Diethylene glycol monobutyl ether acetate	246			0.983	204	16.6	118.2		228-30	82	153, 147		
281	Isobutyl phenylacetate	247			0.999 <sup>18</sup>	192	76.5 (cor)	256.5 (cor)		108.1	156	135-6	87	
282	Ethyl hydrocinnamate (Ethyl β-phenylpropionate)	247.2		1.0147		178	40, 48.7	279-80 (cor)	-117.3	78.32	105, 82	135	93, al	
283	Di-n-propyl succinate	248, 246	-10.4	1.4252	1.011	101	185, 182.8	235d		97.1	mono 157, di 260d, w	mono 179, 80, di 254.5, 55, 260	74, pet eth	
284	Methyl 2-methoxybenzoate	248		1.534 <sup>19, 5</sup>	1.1571 <sup>19</sup>	166	100.1	200	-97	64.65	129		108 (cor), al	
285	Methyl undecylenate (Methyl hendecylenate)	248	-27.5	1.43928	0.889 <sup>15</sup>	198	24.5	275	-97	64.65	87		108 (cor), al	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p-Tolu- dide	3,5-Di- nitro- benzoate	Miscellaneous	
						Equiv- alent	Acid		Alcohol					
							M P, °C	B P °C	M P °C					B P °C
286	Isoamyl levulinate	248.8		1.43102	0.96136	186	33.5	245.6	-117	132	107.8d	108.9, w	61	Semicarba- zone, 91-2, Phenylhyd- razone, 70.2, 2,4-Dinitro- phenylhyd- razone, 50.5 Oxime, 96
287	Diethyl acetone- dicarboxylate	250d			1.113	101	135		-117.3	78.32			93, al	Dianilide, 155, bz, Semicarba- zone, 94.5, Cu(OAc) <sub>2</sub> → Cu enolate, 142.3, grn bz
288	n-Butyl benzoate	250.3	-22.4		1.000	178	122.4	249	-90.2	117.6, 116	130	158	64 62.5	
289	Ethyl phenoxy- acetate	251			1.104 <sup>17.5</sup>	180	98-9	285d	-117.3	78.32	101.5		93, al	
290	Methyl 3-meth- oxybenzoate	252		1.52236	1.131	166	109-10		-97	64.65			108 (cor), al	α-Phenyl- ethylamide, 128.6, 9.0, Benzyl- amide, 111.8, 2.8
291	Diethyl l-malate	253		1.4362	1.1290	95	100-1		-117.3	78.32	dl 156.7	dl 206.7	93, al	[α] <sub>D</sub> <sup>20</sup> -10.18
292	n-Amyl levulinate (n-Pentyl levulinate)	253.4		1.43192	0.96136	186	33.5	245.6	-78.5	138 (cor)	107.8d	108.9, w	46.4	2,4-Dinitro- phenylhyd- razone, 84.2, Oxime, 96
293	n-Butyl phenyl- acetate	254		1.489	0.994	192	76.5, subl	256.5 (cor)	-90.2	117.6, 116	156	135.6	64, 62.5	
294	β-Methoxyethyl benzoate (Methyl "cellosolve" benzoate)	255		1.5040 <sup>25</sup>	1.0891 <sup>25</sup>	180	122.4	249		124.5	130	158		4-Nitro- benzoate, 50.5, dl, al
296	Diethyl pimelate	255	-23.8	1.42985	0.9929	108	105	223 <sup>15</sup>	-117.3	78.32	dl 175	dl 206, al	93, al	N-(β-Amino- ethyl) mor- pholide, 137.9
297	Ethyl benzoyl- formate	256-7		1.5190 <sup>25</sup>	1.222 <sup>25</sup>	178	66		-117.3	78.32	91		93, al	Phenylhyd- razone, 64, 2,4-Di- nitro- phenylhyd- razone, 196.7d (cor)

\*Derivative data given in order m p, crystal color, solvent from which crystallized



TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p Toluide	3,5-Di-nitrobenzoate	Miscellaneous	
						Equiv- alent	Acid		Alcohol					
							M P °C	B P °C	M P °C					B P °C
298	Glyceryl triacetate	258			1.161 <sup>15</sup>	72.7	16.6	118.2	17.9	290d	82	153 147	Tris-4-nitrobenzoate, 188	
299	Ethyl 3-methoxybenzoate	260		1.5161	1.0993	180	109.10		-117.3	78.32		93, al	Benzylamide, 111.8 2,8,α-Phenylethylamide, 128.6-90	
300	β-Ethoxyethyl benzoate ("Cello-solve" benzoate)	260-1 <sup>738,5</sup>		1.4969 <sup>25</sup>	1.0585 <sup>25</sup>	194	122.4	249		135	130	158	75, al	
301	Isobutyl salicylate	260.2		1.50872	1.0639	194	158.3, subl at 76			108.1	142, 139	156	87	
302	n-Amyl n-caprylate (n-Pentyl n-octanoate)	260.21	-34.8	1.43019 <sup>15</sup> He (yel)	0.86132	214	16.3	237 239.3	-78.5	138 (cor)	110, 106	70	46.4	
303	n-Hexyl n-enanthate (n-Hexyl n-heptanoate)	260.9	-47.9	1.42939 <sup>1</sup> He (yel)	0.86114	214	-7.47	223	-51.6, -46.1	157.5	96, 96.5	81	58.4 (cor)	
304	n-Heptyl n-caproate (n-Heptyl n-hexanoate)	260.97	-34.4	1.42934 <sup>15</sup> He (yel)	0.86115	214	-3.9	205.35	-34.6, -33.8	176.8	100.1	74.5	46.47	
305	Ethyl 2-methoxybenzoate	261		1.5224	1.1124	261	100.1	200	-117.3	78.32	129		93, al	
306	n-Octyl n-valerate (n-Octyl n-pentanoate)	261.1	-42.5	1.42743 <sup>15</sup> He (yel)	0.86148	214	-34.5	186.35	-16 -16.7	195	106	74	61.2	
307	Isoamyl benzoate	262.3		1.4950	1.004	192	122.4	249	-117	132	130	158	61	
308	Dimethyl d-camphorate	263		1.46334 <sup>16,9</sup>	1.0747	114	187.5 8.0		-97	64.65	mono (α-amide β-acid), 176, (β-amide- α-acid), 182.3, di 192-3	α 212.4, β 190-6	108 (cor), al	
309	Ethyl undecylenate (Ethyl hendecylenate)	264		1.4449 <sup>23</sup>	0.88271 <sup>13</sup>	212	24.5	275	-117.3	78.32	87		93, al	
310	Isobutyl succinate	265		1.427	0.974	115	185, 182.8	235d		108.1	mono 157, di 260d, w	mono 179 80, di 254.5 5.5, 260	87	

\* Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p-Toluide	3,5-Di nitro benzoate	Miscellaneous	
						Equiv- alent	Acid		Alcohol					
							M P, °C	B P °C	M P °C					B P, °C
311	Ethyl benzoyl-acetate	265 sl d, 270 d		1.5498	1.116	192			-117.3	78.32			93, al	Ketone cleavage → acetophenone, m p 19.65, b p 202
312	Di-isoamyl oxalate (Isoamyl oxalate)	267.8, 262		1.427	0.961	115	189.5 (anh) 101 (+ 2H <sub>2</sub> O)		-117	132	mono 219, di 419d	mono 169, di 268	61	
313	Dimethyl suberate	268	-5	1.43326	1.0198	101	144, 139-41		-97	64.65	mono 125.7, di 216.7	di 218, 219	108 (cor), al	
314	Methyl laurate	268		1.432	0.870	214	44, 42	299	-97	64.65	100, 99	87	108 (cor), al	β-Naphthol → β-naphthyl methyl ether, 72
315	Ethyl 4-methoxybenzoate (Ethyl anisate)	269	7	1.5254	1.1038	180	184.6, 184.2 (cor)	275.80	-117.3	78.32	167, 162.3, w	186	93, al	N-(β-Aminoethyl) morpholide, 130.6
316	Ethyl laurate	269	-1.7	1.4321	0.8671 <sub>10</sub>	228	44, 42	299	-117.3	78.32	100, 99	87	93, al	
317	Trimethyl aconitate	270				72	194-5 (cor) d		-97	64.65	tri turns br at 250, sinters at 260		108 (cor), al	
318	n-Butyl salicylate	270-2, 268		1.51148	1.0728	194	158.3, subl at 76		-90.2	117.6, 116	142, 139	156	64, 62.5	
319	Ethyl cinnamate	271	6.70	1.55982	1.0490	176	133	300	-117.3	78.32	147-8	168	93, al	N-(β-Aminoethyl) morpholide, 121.9
320	Di-n-butyl succinate	274.5	-29.3	1.4298	0.9760	115	185, 182.8	235d	-90.2	117.6, 116	mono 157, di 260d, w	mono 179, di 254.5, 260	64, 62.5	
321	Ethyl 2-nitrobenzoate	275	30			195	146		-117.3	78.32	176		93, al	
322	Triethyl aconitate	275d		1.45562	1.1064	86	194-5 (cor)		-117.3	78.32	tri turns br at 250, sinters at 260		93, al	
323	Di-isopropyl d-tartrate	275			1.1274	117	169.71		-89.5	82.4	mono 171-2, di 196d, al		123, pet eth	[α] <sub>D</sub> <sup>20</sup> +14.886, Phenylhydrazide, 240
324	Ethyl 4-ethoxybenzoate	275			1.076 <sup>21</sup>	194	198, 195-6		-117.3	78.32	202		93, al	Hydrazide, 126-7, al

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p Toluene	3,5-Di-nitrobenzoate	Miscellaneous	
						Equivalent	Acid		Alcohol					
							M P °C	B P °C	M P °C					B P °C
325	<i>n</i> -Octyl <i>n</i> -caproate ( <i>n</i> -Octyl <i>n</i> -hexanoate)	275.2	-28.4	1.43256 <sup>15</sup> He (yel)	0.86032	228	-3.9	205.35	-16 -16.7	195	100.1	74.5	61.2	
326	Isoamyl salicylate	276.8		1.50799	1.0535	208	158.3 subl at 76		-117	132	142.139	156	61	
327	<i>n</i> -Heptyl <i>n</i> -enanthate ( <i>n</i> -Heptyl <i>n</i> -heptanoate)	277.2	-33.3	1.43183 He (yel)	0.86039	228	-7.47	223.0	-34.6 -33.8	176.8	96.965	81	46.47	
328	<i>n</i> -Hexyl <i>n</i> -caprylate ( <i>n</i> -Hexyl <i>n</i> -octanoate)	277.44	-30.6	1.43230 <sup>1</sup> He (yel)	0.86033	228	16.3	237 239.3	-51.6 -46.1	157.5	110.106	70	58.4 (cor)	
329	Resorcinol diacetate	278 sl d			1.179	97	16.6	118.2	110 (stab) 108 8.5 (labile)	280.8 (cor)	82	153 147	di 201	
330	Diethyl suberate	282	5.9	1.43236	1.9807	115	144 139.41		-117.3	78.32	mono 125.7 di 216-7	di 218-9	93 al	N-(β-Aminoethyl) morpholide, 157.2
331	Resorcinol monoacetate	283				152	16.6	118.2	110 (stab) 108- 8.5 (labile)	280.8 (cor)	82	153 147	di 201	
332	Dimethyl phthalate (Methyl phthalate)	283.8		1.5138	1.191	97	200.6 191 (sealed tube)		-97	64.65	mono 149 di 220	mono 150 (slow htng) 160.5 (rapid htng)	108 (cor) al	
333	Diethyl isophthalate	286 <sup>733</sup>	11.5			111	348 (subl)		-117.3	78.32	mono 280 di 280		93 al	
334	Diethyl <i>d</i> -camphorate	286		1.45354 <sup>26 2</sup>	1.0298	128	187.5- 8.0		-117.3	78.32	mono (α amide β-acid) 176 (β amide- α-acid) 182.3, di 192.3	α 212- 4 β 190-6	93, al	
335	Glyceryl tripropionate	289			1.083 <sup>19</sup>	86.7	-20.8	141	17.9	290d	81.813, 79	126 123		Tris-4-nitrobenzoate, 188

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. I) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p-Tolu- dide	3,5-Di- nitro- benzoate	Miscellaneous	
						Equiv alent	Acid		Alcohol					
							M P °C	B P °C	M P °C					B P, °C
336	Diethyl phthalate (Ethyl phthalate)	289.5, 298		1.5019	1.1175	111	200.6, 191 (sealed tube)		-117.3	78.32	mono 149, di 220	mono 150 (slow htng), 160.5 (rapid htng)	93, al	
337	n-Heptyl n-caprylate (n-Heptyl n-octanoate)	290.6	-10.2	1.43492 <sup>1</sup> He (yel)	0.85958	242	16.3	237 239.3	-34.6, -33.8	176.8	110, 106	70	46, 47	
338	n-Octyl n-enanthate (n-Octyl n-heptanoate)	290.8	-21.5	1.43488 <sup>1</sup> He (yel)	0.85961	242	-7.47	223.0	-16, -16.7	195	96, 96.5	81	61.2	
339	Diethyl azelate	291	-18.5	1.43509	0.97294	122	106.5	>360 sl d 237 <sup>15</sup>	-117.3	78.32	mono 93.5 di 175	di 201-2	93, al	N-(β-Aminoethyl) morpholide, 141.3
340	Triethyl citrate	294		1.44554	1.1369	92	153 (anh) 100 (+1 H <sub>2</sub> O)		-117.3	78.32	tri 210 5d, w	tri 189, al	93, al	
341	Ethyl myristate	295	α 11.9 β 12.3	1.4362	0.8573 <sup>25</sup>	256	53.9	202 <sup>16</sup>	-117.3	78.32	103	93	93, al	N-(β-Aminoethyl) morpholide, 76
342	Di-n-propyl d-tartarate	297			1.1390	117	169.71			97.1	mono 171-2, di 196d, al		74, pet eth	[α] <sub>D</sub> <sup>20</sup> +12.00, Phenylhydrazide, 240
343	Isoamyl succinate	297		1.434	0.958	129	185 182.8	235d	-117	132	mono 157 di 260d, w	mono 179- 80, di 254.5 5.5, 260	61	
344	Di-(β-n-butoxyethyl) carbonate	297.8		1.4279 <sup>25</sup>	0.9766 <sup>65</sup>	262					170.6 <sup>743</sup>			
345	Diethyl benzylmalonate	300			1.077 <sup>15</sup>	125	117d		-117.3	78.32	225		93, al	
346	α-Tetrahydrofurfuryl benzoate	300.2 <sup>50</sup>			1.137 <sup>60</sup>	206	122.4	249		177 8 <sup>743</sup>	130	158	83-4	
347	Di-isopropyl phthalate (Iso-propyl phthalate)	302			1.065 <sup>19</sup>	115	200.6, 191 (sealed tube)		-89.5	82.4	mono 149 di 220	mono 150 (slow htng), 160-5 (rapid htng)	123, pet eth	
348	n-Octyl n-caprylate (n-Octyl n-octanoate)	306.8	-15.1	1.43698 <sup>15</sup> He (yel)	0.85919	256	16.3	237, 239.3			110, 106	70	61.2	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XVI. ORGANIC DERIVATIVES OF ESTERS**  
Including esters of inorganic acids

**a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p-Toluide	3,5-Di nitrobenzoate	Miscellaneous	
						Equiv- alent	Acid		Alcohol					
							M P, °C	B P °C	M P, °C					B P °C
349	Diethyl sebacate	307	1.3	1.43657	0.9631	129	33, subl	243 <sup>15</sup>	-117.3	78.32	mono 170 di 210, 208	di 201	93, al	
350	2-Tolyl benzoate ("o-Cresyl" benzoate)	307			1.114 <sup>19</sup>	212	122.4	249	31	191.2	130	158	138.4 (cor), al	
351	Ethyl 1-naphthoate	309			1.1274 <sup>15</sup>	200	161.2 (cor)		-117.3	78.32	202	205	93, al	
352	Glyceryl tributyrate	318			1.033 <sup>1</sup>	100.7	-5.5 -8	162.5, 164	17.9	290d	115.6	75		Tris-4-nitrobenzoate, 188
353	Di-n-butyl d,l-tartarate (Di-n-butyl racemate)	320			1.0879 <sup>18</sup>	131	205.6 (anh), 203-4 (+1 H <sub>2</sub> O)		-90.2	117.6, 116	di 226, w-me al		64, 62.5	Dianilide, 235-6
354	Benzyl salicylate	320				228	158.3, subl at 76		-15.3	205.5	142, 139	156	113	
355	Di-n-butyl phthalate (n Butyl phthalate)	340.7		1.4900	1.047 <sup>20</sup> / <sub>20</sub>	139	200.6, 191 (sealed tube)		-90.2	117.6, 116	mono 149, di 220	mono 150 (slow htng), 160.5 (rapid htng)	64, 62.5	N-(β-Aminoethyl) morpholide, 124
356	Di-n-butyl sebacate	345			0.9329 <sup>15</sup>	157	133, subl	243 <sup>15</sup>	-90.2	117.6, 119	mono 126.5, di 210, 208	di 201	64, 62.5	Phenylhydrazide, 194
357	Di-isoamyl phthalate (Isoamyl phthalate)	349			1.024 <sup>17</sup>	153	200-6, 191 (sealed tube)		-117	132	mono 149, di 220	mono 150 (slow htng), 160-5 (rapid htng)	61	
358	Tricresyl phosphate	400d, 275, 80 <sup>20</sup>	-30	1.5568	1.197 <sup>25</sup>	122.7			36	202.32			188.6 (cor), al	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Reduced pressure b.p. only

a) Liquids. 2) (Listed in order of increasing m.p. of the corresponding amide)\*

No	Name	Boiling point °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p-Tolu- dide	3,5-Di- nitro- benzoate	Miscellaneous	
						Equiv- alent	Acid		Alcohol					
							M P, °C	B P °C	M P, °C					B P, °C
1	3,5-Dimethylphenyl acetate ( <i>Sym-m-Xylenyl</i> acetate)	130 <sup>26</sup> , 120 <sup>11</sup>				164	16.6	118.2	63.2 68	220.2	82	153, 147	195.4, al	
2	Dimethyl azelate	156 <sup>20</sup> , 146.2 <sup>10</sup>		1.43607	1.0069	108	106	>360 sl d	-97	64.65	<i>mono</i> 93.5, <i>di</i> 172	<i>di</i> 201.2, 198	108 (cor), al	
3	Dimethyl adipate	107.6 <sup>11</sup>	8.5	1.4277	1.0625	87	153.4 (cor)	216 <sup>15</sup>	-97	64.65	<i>mono</i> 125 30, w, <i>di</i> 220	241	108 (cor), al	
4	$\beta$ - <i>n</i> -Butoxyethyl benzoate (Butyl "cellosolve" benzoate)	156.5 70 <sup>14</sup> , 131.6 26 <sup>30</sup>		1.4925 <sup>25</sup>	1.0277 <sup>23</sup>	222	122.4	249		170 6 <sup>11</sup>	130	158		4-Nitro- phenylure- thane, 58.7 9.1, CCl <sub>4</sub>
5	Ethyl fuoylacetate	170 <sup>20</sup> 143 <sup>10</sup>		1.5055 <sup>16</sup>	1.1651 <sup>7</sup>				-117.3	78.32	159, al		93, al	Oxime, 131.2, dil, al
6	Methyl fuoylacetate	144.5 <sup>20</sup> , 96.8 <sup>1</sup>							-97	64.65	159, al		108 (cor), al	Semicarba- zone, 141- 2, bz-al (3.1), Oxime, 124.5, bz
7	Di- <i>n</i> -propyl adipate	155 <sup>16</sup>	-20	1.4314	0.9790	115	153.4			97.1	<i>mono</i> 161 <i>di</i> 220	<i>di</i> 241	74, pet eth	
8	Dimethyl pimelate	119.3 96 <sup>10</sup>	-20.6	1.42888	1.0383	94	105		-97	64.65	<i>di</i> 175	<i>di</i> 206, al	108 (cor), al	
9	Di- <i>n</i> -propyl maleate	114-7 <sup>6</sup>		1.444 <sup>18</sup> , <sup>3</sup>	1.026	100	137			97.1	<i>di</i> 181, me al	<i>mono</i> 195d, chl, <i>di</i> 142, eth	74, pet eth	

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point, °C	Boiling point, °C	Saponification				Amide	<i>p</i> -Toluidide	3,5-Dinitrobenzoate	Miscellaneous		
				Equiv alent	Acid		Alcohol						
					M P, °C	B P, °C	M P °C					B P °C	
1	Dimethyl succinate	18.2	196	73	185, 182.8	235d	-97	64.65	64.65	<i>mono</i> 157, <i>di</i> 260d	<i>mono</i> 179.80, <i>di</i> 254.5, 5.5, 260	108 (cor), al	$n_D^{20}$ 1.41965, $D_4^{20}$ 1.1192
2	Methyl myristate	18.5	323	242	53.9	202 <sup>16</sup>	-97	64.65	103		93	108 (cor), al	$n_D^{20}$ 1.428
3	Ethyl piperonylate	18.5	286	194		228, 229	-117.3	78.32	169, al			93, al	
4	Diethyl <i>d</i> -tartarate	18.6	280	103	169.71		-117.3	78.32	<i>mono</i> 171-2, <i>di</i> 196d, al			93, al	$n_D^{20}$ 1.44677, $D_4^{20}$ 1.2028 [ $\alpha$ ] <sub>15</sub> <sup>20</sup> (grn) + 7.87, Phenylhydrazide, 204
5	Phenyl propionate	20	211	150	-20.8	141	41.8, 42	182, 183	81	123, 126		145.8 (cor), al	$D_{25}^{25}$ 1.0467, Tri-bromo, 95
6	Ethyl margarate	20.6 ( $\beta$ )		298	61.2	231 <sup>16</sup>	-117.3	78.32	108, 106			93, al	
7	Methyl 3-chlorobenzoate	21	231	170.5	158, 155		-97	64.65	134			108 (cor), al	
8	Benzyl benzoate	21	323-4 (cor)	212	122.4		-15.3	205.5	130	158		113	$n_D^{21}$ 1.5681, $D^{19}$ 1.1224
9	Di- <i>n</i> -butyl <i>d</i> -tartarate	22		131	169.71		-90.2	117.6, 116	<i>mono</i> 171-2, <i>di</i> 196d, al			64, 62.5	$D_4^{18}$ 1.0886, [ $\alpha$ ] <sub>15</sub> <sup>18</sup> + 10.09, Phenylhydrazide, 240
10	3,4-Dimethylphenyl acetate	22	235	164	16.6	118.2	62.5	225	82	153, 147		181.6, rods, al	
11	Isobutyl stearate	(a) 22.5, (b) 28.9, (two forms)		340	70.1			108.1	109, 108.4, al	102		87	
12	Isoamyl stearate	23		354	70-1		-117	132	109, 108.4, al	102		61	
13	Cetyl acetate ( <i>n</i> -Hexadecyl acetate)	$\alpha$ 18.5, $\beta$ 24.2, 22		284	16.6	118.2	49.27	190 <sup>18</sup>	82	153, 147		66	
14	Ethyl palmitate	$\alpha$ 19.4, $\beta$ 24.2	185	284	62.7	222 <sup>16</sup>	-117.3	78.32	106-7, 105.3, al	98		93, al	
15	Methyl anthranilate (Methyl 2-aminobenzoate)	24.4	299.8	151	146		-117.3	78.32	109	151		93, al	N-( $\beta$ -Aminoethyl) morpholide, 126, Picrate, 106
16	Di- <i>n</i> -propyl <i>d,l</i> -tartarate	25	286 <sup>765</sup>	117	203-4 (+1 H <sub>2</sub> O), 205-6 (anh)			97.1	226, w-me al			74, pet eth	$D_4^{20}$ 1.1256
17	Dimethyl sebacate	26.6, 27-8		115	133, subl	243 <sup>15</sup>	-97	64.65	<i>mono</i> 170, <i>di</i> 210, 208	<i>di</i> 201		108 (cor), al	$n_D^{25}$ 1.43549, $D_4^{25}$ 0.98818, Phenylhydrazide, 194

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Saponification				Amide	<i>p</i> -Toluidide	3,5-Dinitrobenzoate	Miscellaneous	
				Equivalent	Acid		Alcohol					
					M P °C	B P °C	M P °C					B P °C
18	Methyl β-(2-furyl) acrylate	27	227	152	141	286	-97	64 65	168 9		108 (cor), al	
19	<i>n</i> -Butyl stearate	27 5, 28		340	70 1		-90 2	117 6, 116	109 108 4, al	102	64 62 5	
21	<i>d</i> -Bornyl acetate	29	226, 221	196	16 6	118 2	204 5 5 5	212	82	153, 147	154	$n_D^{20}$ 1 4633, $D_4^{15}$ 0 991 (undercooled)
22	Methyl margarate	29		284	61 2	231 <sup>16</sup>	-97	64 65	108, 106		108 (cor), al	
23	Eugenyl acetate	30	282	206	16 6	118 2	-9 1	253	82	153, 147	130 8 (cor), 95% al	$n_D^{20}$ 1 52069 $D_4^{15}$ 1 087
24	Methyl palmitate	30	184 <sup>12</sup>	270	62 7	222 <sup>16</sup>	-97	64 65	106 7 105 3, al	98	108 <sup>7</sup> (cor), al	$n_D^{25}$ 1 4317
25	<i>n</i> -Amyl stearate ( <i>n</i> -Pentyl stearate)	30		354	70 1		-78 5	138 (cor)	109, 108 4, al	102	136 (cor)	
26	Ethyl 2-nitrobenzoate	30	275	195	146		-177 3	78 32	176		93, al	
27	<i>n</i> -Octadecyl acetate	α 29 97, β 31 95		312	16 6	118 2	α 57 95, 59 5	210 5 <sup>15</sup>	82	153, 147	66	β-Form exist below 0°, α-Form seeding with crys or cooling soln of the compound
28	Ethyl 2-naphthoate	32	304	200	184, 185 5		-117 3	78 32	192-3, 195, al	192, al	93, al	$n_D^{20}$ 1 596, $D_4^{20}$ 1 117
29	Methyl-3-bromobenzoate	32		229	155		-97	64 65	155		108 (cor), al	
30	Methyl 4-toluate	33	222 5, 217	150	179-80, subl	275 (cor)	-97	64 65	160, 158	160, 165	108 (cor), al	
31	Thymyl benzoate	33		255	122 4		51 5	233 5	130	158	103 2, al	
32	Di-(β-ethoxyethyl) phthalate	33		155	200 6, 191 (sealed tube)			134 8	mono 149, di 220	mono 150 (slow htng), 160-5 (rapid htng) di 201	75, al	
33	Ethyl stearate	α 30 9, β 33 5	199 <sup>10</sup>	312	70-1		-117 3	78 32	109, 108 4, al	102	93, al	α → β Slowly on rubbing, N-(β-Aminoethyl) morpholide, 58
34	Di-isopropyl <i>d,l</i> -tartarate	34	275 <sup>765</sup>	117	203 4 (+ 1H <sub>2</sub> O), 205-6 (anh)		-89 5	82 4	226, w-me, al		123, pet eth	$D_4^{20}$ 1 1166
35	Ethyl pyromucate (Ethyl furoate)	34	197	140	133 4, 132	230-2	-117 3	78 32	142-3	170 5, al	93, al	$n_D$ 1 4797, $D_4^{20}$ 1 1174 (undercooled)
36	Diethyl 4-nitrophthalate	34		133 5	165		-117 3	78 32	200 d	mono 172	93, al	
37	Ethyl benzilate	34		256	150		-117 3	78 32	153, chl	189-90	93, al	

\* Derivative data given in order m p, crystal color, solvent from which crystallized



**TABLE XVI. ORGANIC DERIVATIVES OF ESTERS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point °C	Saponification				Amide	p-Toluidide	3,5-Dinitro benzoate	Miscellaneous	
				Equiv alent	Acid		Alcohol					
					M P °C	B P °C	M P °C					B P °C
38	2,4,5-Trimethylphenyl acetate (Pseudocumenyl acetate)	34-45	245.6	178	16.6	118.2	71	232	82	153, 147		
39	Methyl cinnamate	36	261	162	133	300	-97	64.65	147.8	168	108 (cor), al	
40	Ethyl <i>d,l</i> -mandelate	37	254	180	118		-117.3	78.32	133.4	172, al	93, al	
41	Dimethyl itaconate	38	208	79	165		-97	64.65	<i>di</i> 191.28, al		108 (cor), al	
42	Methyl sebacate	38	288d	216	133, subl	243 <sup>15</sup>	-97	64.65	<i>mono</i> 170, <i>di</i> 210, 208	<i>di</i> 201	108 (cor), al	
43	Methyl stearate	38.8	214-5 <sup>15</sup>	298	70-1		-97	64.65	109, 108.4, al	102	108 (cor), al	
44	Benzyl cinnamate	39		238	133	300	-15.3	205.5	147	168	113	
45	Methyl dibenzylacetate	41		254	89		-97	64.65	128.9, bz	175, abs al	108 (cor), al	
46	Phenyl salicylate (Salol)	42		214	158.3, subl at 76		41.8, 42	182, 183	142.139	156	145.8 (cor), al	
47	Benzyl succinate	42		208	185, 182.8	235d	-15.3	205.5	<i>mono</i> 157, <i>di</i> 260d	<i>mono</i> 179.80, <i>di</i> 254.5, 5.5, 260	113	
48	Dibenzyl phthalate	43		173	200.6, 191 (sealed tube)				<i>mono</i> 149, <i>di</i> 220	<i>mono</i> 150 (slow htng), 160.5 (rapid htng), <i>di</i> 201	113	
49	Diethyl terephthalate	44	302	111	300, subl without melting		-117.3	78.32	>225		93, al	
50	Cinnamyl cinnamate	44		264	133	300	33	257	147-8	168	121	
51	Ethyl 2-nitrocinnamate	44		221	240		-117.3	78.32	185		93, al	
52	Methyl 2-chlorocinnamate	44		196.5	212, yel, al		-97	64.65	168		108 (cor), al	
53	Diethyl 3-nitrophthalate	46		133.5	218		-117.3	78.32	<i>di</i> 201d	<i>di</i> 226	93, al	
54	Ethyl 3-nitrobenzoate	47	296	195	140		-117.3	78.32	<i>di</i> 187, 189.90, dil me al		93, al	
55	Dicyclohexyl oxalate	47, 42		127	189.5 (anh), 101 (+ 2H <sub>2</sub> O)		25.15	161.1	<i>mono</i> 219, <i>di</i> 419d	<i>mono</i> 168, <i>di</i> 268	112-3, al	
56	2-Phenylethyl cinnamate	47.8		252	133	300	-25.8	219.8	147.8	168	108	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Saponification				Amide	<i>p</i> -Toluidide	3,5-Di-nitrobenzoate	Miscellaneous	
				Equivalent	Acid		Alcohol					
					M P, °C	B P, °C	M P, °C					B P, °C
58	1-Naphthyl acetate	48-49		186	16.6	118.2	94	278-80	82	153, 147	217.4, yellow	
59	Methyl 4-methoxybenzoate (Methyl anisate)	49, 45	255	166	184-6	275-80	-97	64-65	167, 162.5, w	186	108 (cor), al	
60	Phenacyl acetate (Benzoylcarbonyl acetate, ω-Acetoxyacetophenone)	49		178	16.6	118.2	86	118-20 <sup>11</sup>	82	153, 147		
61	Di-3-tolyl carbonate (Di-" <i>m</i> -cresyl" carbonate)	49		242				12	203		165.4 (cor), al	
62	Triphenyl phosphate	49	260 <sup>20</sup>	108.7			41.8, 42	182, 183			145.8 (cor), al	D <sub>2</sub> <sup>o</sup> 185, Tri-bromo deriv of phenol, 95
63	Dibenzyl <i>d</i> -tartarate	50		165	169-71		-15.3	205.5	<i>mono</i> 171.2, <i>di</i> 196d, al		113	Phenylhydrazide, 240
64	Dibenzyl succinate	51.2		149	185, 182.8	235d	-15.3	205.5	<i>mono</i> 157, <i>di</i> 260d	<i>mono</i> 179.80, <i>di</i> 254.5, 5.5, 260	113	
65	Methyl piperonylate	51-2	270-1 <sup>777</sup>	180	229, 228		-97	64-65	169, al		108 (cor), al	
66	Cetyl palmitate ( <i>n</i> -Hexadecyl palmitate)	51.6		480	62.7	222 <sup>16</sup>	49.27	190 <sup>18</sup>	106.7, 105.3, al	98	66	
68	Furfuryl diacetate	52	220	99	16.6	118.2			82	153, 147		Hydrolysis → furfural, b p, 161.7, Semicarbazone, 202
69	Ethylene glycol dilaurate	52		213	44, 42	299	-12.6	197.85	100, 99	87	169	
70	Phenyl stearate	52		360	70-1		41.8, 42	182, 183	109, 108.4, al	102	145.8 (cor), al	Tribromo deriv of phenol, 95
71	Methyl <i>d</i> / <i>l</i> -mandelate	53.3	250 sl d	166	118		-97	64-65	133-4	172, al	108 (cor), al	
72	Dimethyl tartronate	53.4		74	156-8d		-97	64-65	<i>di</i> 198, dil al		108 (cor), al	
73	Dimethyl oxalate	54	163.5 <sup>202</sup>	59	189.5 (anh), 101 (+ 2H <sub>2</sub> O)		-97	64-65	<i>mono</i> 219, <i>di</i> 419d	<i>mono</i> 168, <i>di</i> 268	108 (cor), al	
74	Tetraethyl pyromellitate	54		91.5	275		-117.3	78.32			93, al	
75	Diethyl <i>meso</i> -tartrate	55		103	140		-117.3	78.32	<i>di</i> 187, 189-90, dil me al		93, al	Bis-phenylhydrazide, 245

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Saponification				Amide	<i>p</i> -Toluidide	3,5-Di-nitro benzoate	Miscellaneous	
				Equiv alent	Acid		Alcohol					
					M P, °C	B P, °C	M P °C					B P °C
76	3-Tolyl benzoate ("m-Cresyl" benzoate)	55	314	212	122.4	249	12	203	130	158	165.4 (cor), al	N-(β-Aminoethyl) morpholide, 186.3
77	Ethyl 4-nitrobenzoate	56	186.3	195	241		-117.3	78.32	201, 198	204, 192	93, al	
78	1-Naphthyl benzoate	56		248	122.4	249	94	278-80	130	158	217.4, yellow, al	
79	Cetyl stearate ( <i>n</i> -Hexadecyl stearate)	56.6		508	70-1		49.27	190 <sup>18</sup>	109, 108.4, al	102	66	
80	Di-isobutyl <i>d,l</i> -tartarate	58	311	131	203.4 (+ 1H <sub>2</sub> O), 205.6 (anh)			108.1	<i>di</i> 226, <i>w-me</i> al		87	
81	Ethyl diphenylacetate	58		240	148		-117.3	78.32	167.5, 80	172.3	93, al	N-(β-Aminoethyl) morpholide, 150.2
82	Ethyl 2-benzoylbenzoate	58		254	128 (anh) 91 (+ 1H <sub>2</sub> O), <i>w</i>		-117.3	78.32	165 (cor), 162		93, al	
83	Diethyl naphthalate	58-60		136	274		-117.3	78.32			93, al	
84	Methyl diphenylacetate	60		226	148		-97	64.65	167.5, 80	172.3	108 (cor), al	
85	Di-2-tolyl carbonate (Di-"o-cresyl" carbonate)	60		242			30.75	190.8			138.4 (cor), al	
86	Methyl 2-(4-tolyl)-benzoate	61		254	139-46		-97	64.65	175.6, al		108 (cor), al	
87	Dimethyl <i>d</i> -tartarate	61.5		89	169.71		-97	64.65	<i>mono</i> 171.2, <i>di</i> 196d, al		108 (cor), al	Two other forms, m p 48 and 50, Phenylhydrazide, 240
88	Ethylene glycol dimyristate	63.0		241	53.9	202 <sup>16</sup>	-12.6	197.85	103	93	169	
89	Dimethyl 4-nitro-phthalate	66		119.5	165		-97	64.65	200d	<i>mono</i> 172	108 (cor), al	
90	Dicyclohexyl phthalate	66		165	200-6 191 (sealed tube)		25.15	161.1	<i>mono</i> 149, <i>di</i> 220	<i>mono</i> 150 (slow htng), 160-5 (rapid htng), <i>di</i> 201	112-3, al	n <sub>D</sub> <sup>20</sup> 1.451, D <sub>4</sub> <sup>20</sup> 1.383
92	Ethyl oxanilate	66-7		193	148.9		-117.3	78.32	228		93, al	
93	Dimethyl isophthalate	67.8		97	348, subl		-97	64.65	<i>mono</i> 280, <i>di</i> 280		108 (cor), al	
94	Ethyl 2-(4-tolyl)benzoate	68, 69	314, 299	268	139-40		-117.3	78.32	175.6, <i>w</i>		93, al	
95	Phenyl benzoate	69, 71	314	198	122.4	249	41.8, 42	182, 183	130	158	145.8 (cor), al	AlCl <sub>3</sub> → 4-Hydroxy benzophenone, Tribromo deriv of phenol, 95

\* Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XVI. ORGANIC DERIVATIVES OF ESTERS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Saponification				Amide	<i>p</i> -Toluidide	3,5-Di-nitrobenzoate	Miscellaneous	
				Equiv- alent	Acid		Alcohol					
					M P °C	B P °C	M P °C					B P °C
96	Dimethyl 3-nitro-phthalate	69		133.5	218		-97	64.65	<i>di</i> 201d	<i>di</i> 226	108 (cor), al	
97	Methyl 3-hydroxy-benzoate	70		152	200, subl		-97	64.65	170.167	163, dil al	108 (cor), al	
98	Ethylene glycol di-palmitate	70.5-69		269	62.7	222 <sup>16</sup>	-12.6	197.85	106.7, 105.3, al	98	169	
99	2-Naphthyl acetate	71		186	16.6	118.2	123	285.6	82	153.147	210.2 al	
100	Glyceryl tristearate	71		297	70.1		17.9	290d	109, 108.4 al	102		n <sup>20</sup> 1.4399 D <sub>4</sub> <sup>20</sup> 0.862
101	4-Tolyl benzoate ("p-Cresyl" benzoate)	71	316	212	122.4	249	36	202	130	158	188.6 (cor), al	
102	Glyceryl tribenzoate	72, lgr, 76, al		135	122.4	249	17.9	290d	130	158		
103	Phenyl cinnamate	72		238	133	300	41.8-42	182, 183	147.8	168	145.8 (cor), al	Tribromo deriv of phenol, 95
104	Ethylene glycol dibenzoate	73		135	122.4	249	-12.6	197.85	130	158	<i>di</i> 169	
105	Methyl 2-nitro-cinnamate	73		207	240		-97	64.65	185		108 (cor), al	
106	Di-isobutyl <i>d</i> -tartarate	73-4, 70		131	169.71			108.1	<i>mono</i> 171.2, <i>di</i> 169d, al		87	Phenylhydrazide, 240
107	Ethyl 3-hydroxy-benzoate	73.8	282	166	200, subl		-117.3	78.32	170, 167	163, dil al	93 al	
108	Diphenyl phthalate (Phenyl phthalate)	74-5, 70		159	200.6, 191 (sealed tube)		41.8, 42	182, 183	<i>mono</i> 149, <i>di</i> 220	<i>mono</i> 150 (slow htng), 160.5 (rapid htng), <i>di</i> 201	145.8 (cor), al	Tribromo deriv of phenol, 95
109	Methyl 3-hydroxy-2-naphthoate	75		202	222-3 (cor)		-97	64.65	217.8 (cor), yel, al	221-3	108 (cor), al	
110	Methyl benzilate	75		242	150		-97	64.65	154.5, chl	189.90	108 (cor), al	
111	Ethylene glycol di- <i>n</i> -stearate	76, 73		297	70, 69.6		-12.6	197.85	109, 108.4, al	102	169	
112	Trimethyl citrate	76, 78.9	283.7d	78	100, 153 (anh)		-97	64.65	<i>tri</i> 210-5d, w	<i>tri</i> 189, al	108 (cor), al	
113	Methyl 2-naphthoate	77	290	186	184, 185.5		-97	64.65	192-3, al	192, al	108 (cor), al	
114	Methyl $\alpha$ -phenyl- <i>n</i> -butyrate	77-8		178	42	270	-97	64.65	85-7		108 (cor), al	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	Saponification				Amide	<i>p</i> -Toluidide	3,5-Dinitrobenzoate	Miscellaneous	
				Equiv- alent	Acid		Alcohol					
					M P., °C	B P., °C	M P., °C					B P., °C
115	Diphenyl carbonate	78	306	214			41 8, 42 182 183			145 8 (cor), al	Phenylhydrazine → N,N'-diphenylcar- bazide, Tribromo deriv of phenol, 95	
116	Methyl 3-nitrobenzoate	78	279	181	140		-97 64 65	143	162	108 (cor), al		
117	Ethyl 3-nitrocinnamate	79		221	199		-117 3	78 32	196	93, al	Dibromide, 132-3	
118	Isoeugenyl acetate	79	283	206	16 6	118 2		267 5	82	153, 147		
119	Methyl 2-benzoyl- benzoate	79-80, 52	352	240	128 (anh), 91 (+1 H <sub>2</sub> O), w		-97	64 65	165 (cor), 162	108 (cor), al		
120	Benzyl oxalate	80		135	189 5 (anh) 101 (+2 H <sub>2</sub> O)		-15 3	205 5	<i>mono</i> 219, <i>di</i> 419d	<i>mono</i> 169 <i>di</i> 268		113
121	Methyl 4-bromobenzoate	81		215	251 3		-97	64 65	189 90, w	108 (cor), al		
122	Benzoin acetate	83		254	16 6	118 2	133	344	82	153, 147		
123	Pentaerythritol tetra- acetate	84		76	16 6	118 2	262 253		82	153, 147		
124	Pyrocatechol dibenzoate (Catechol dibenzoate)	84		159	122 4	249	105	245 6	130	158	<i>di</i> 152	
125	Ethyl 3-hydroxy-2- naphthoate	85	291	216	222 3 (cor)		-117 3	78 32	217 8 (cor), yel, al	221-3	93, al	
126	Diguaiacol carbonate (Di-(2-methoxyphenyl) carbonate, "Guaiacol carbonate")	87		274			32	205			141 2 (cor), al	Monobromo deriv, 178
127	Dimethyl <i>d l</i> -tartarate	90 (stab), 84 (meta- stab)	282	89	203 4 (+1 H <sub>2</sub> O), 205 6 (anh)		-97	64 65	226, w - me al		108 (cor), al	
128	Di-2-tolyl oxalate (Di- "o-cresyl" oxalate)	91		135	189 5 (anh), 101 (+2 H <sub>2</sub> O)		30 75	190 8	<i>mono</i> 219 <i>di</i> 419d	<i>mono</i> 169, <i>di</i> 268	138 4 (cor), al	
129	Ethyl 3,5-dinitroben- zoate	94, 93		240	204-5		-117 3	78 32	183		93, al	N-(β-Aminoethyl) morpholide, 189 5
130	2-Naphthyl salicylate	95 5, 93 5		264	158 3 subl at 76		123	285-6	142, 139	156	210 2, al	
131	Methyl 4-nitrobenzoate	96		181	241		-97	64 65	201, 198	204, 192	108 (cor), al	
132	<i>n</i> -Propyl 4-hydroxy- benzoate	96		180	215, 210			97 1	162 (+1 H <sub>2</sub> O), w	203-4, al	123, pet eth	
133	1,2,4-Triacetoxybenzene (("Hydroquinone tri- acetate"))	96-7		76	16 6	118 2	140 5		82	153, 147		

\* Derivative data given in order m p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point °C	Saponification				Amide	<i>p</i> -Toluidide	3,5-Dinitrobenzoate	Miscellaneous	
				Equiv. alent	Acid		Alcohol					
					M P °C	B P °C	M P °C					B P °C
134	Ethyl 3,5-dinitrosalicylate	99		256	182, 173 (+1 H <sub>2</sub> O)		-117 3	78 32	181		93, al	
135	Dimethyl fumarate	101 7	193 25	72	286 7 (sealed tube), subl 200		-97	64 65	<i>mono</i> 270, 300 2 <i>di</i> 266d		108 (cor), al	$n_D^{20} 1.40625$ , $D^{110} 1.0397$
136	Ethyl 5-nitrosalicylate	102		211	229 30		-117 3	78 32	225		93, al	
137	Dimethyl naphthalate	104		122	274		-97	64 65			108 (cor), al	
138	Di-3-tolyl oxalate (Di-" <i>m</i> -cresyl" oxalate)	105		135	189 5 (anh), 101 (+2 H <sub>2</sub> O)		12	203	<i>mono</i> 219, <i>di</i> 419d	<i>mono</i> 169, <i>di</i> 268	164 5 (cor), al	
139	Phloroglucinol triacetate (1,3,5-Triacetoxybenzene)	105-6		76	16 6	118 2	200 9 (slow htng), 217 9 (rapid htng)		82	153, 147	<i>tri</i> 162	
140	Diphenyl adipate	106		149	153-4 (cor)	216 <sup>15</sup>			<i>mono</i> 125-30, <i>w, di</i> 220	241	145 8 (cor), al	Tribromo deriv of phenol, 95
141	Acetylsalicylaldehyde diacetate ("Salicylaldehyde triacetate")	107, 103		89	16 6	118 2			82	153, 147		Hydrolysis → salicylaldehyde, b p 197 (cor)
142	2-Naphthyl benzoate	107		248	122 4	249	123	285-6	130	158	210 2, al	
143	Methyl 3,5-dinitrobenzoate	108		226	204 5		-97	64 65	183		108 (cor), al	
144	Dimethyl mesotartrate	111		89	140		-97	64 65	<i>di</i> 187, 189 90, <i>dil me</i> al		108 (cor), al	Bis-phenylhydrazide, 245
145	Di-4-tolyl carbonate (Di-" <i>p</i> -cresyl" carbonate)	114		242			36	202			188 6 (cor), al	
146	Ethyl oxamate	114 5		117	210		-117 3	78 32	419d		93, al	
147	Cholesteryl acetate	114		416	16 6	118 2	148 5		82	153, 147		
148	Ethyl 4-hydroxybenzoate	116		166	215, 210		-117 3	78 32	162 (+1 H <sub>2</sub> O), <i>w</i>	203-4, al	93, al	N-(β-Aminoethyl) morpholide, 184
149	Resorcinol dibenzoate	117		159	122 4	249	110 (stab), 108 8 5 (labile)	280 8 (cor)	130	158	<i>bis</i> 201	
150	Ethyl 3-nitrosalicylate	118		211	125 (+1 H <sub>2</sub> O)		-117 3	78 32	145		93, al	
151	Methyl 5-nitrosalicylate	119		197	229 30		-97	64 65	225		108 (cor), al	

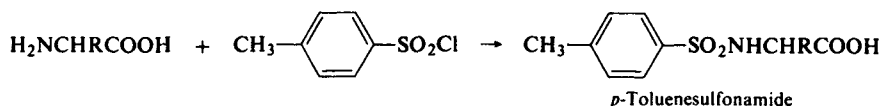
\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Saponification				Amide	<i>p</i> -Toluidide	3,5-Dinitrobenzoate	Miscellaneous	
				Equiv- alent	Acid		Alcohol					
					M P °C	B P °C	M P °C					B P °C
152	Diphenyl succinate	121		135	185 182 8	235d	41 8, 42	182, 183	<i>mono</i> 157, <i>di</i> 260d	<i>mono</i> 179 80, <i>di</i> 254 5 5 5, 260	148 5 (cor ), al	Tribromo deriv of phenol, 95
153	Di-4-tolyl succinate (Di- "p-cresyl" succinate)	121		149	185 182 8	235d	36	202	<i>mono</i> 157, <i>di</i> 260d	<i>mono</i> 179 80, <i>di</i> 254 5- 5 5, 260	188 6 (cor ), al	
154	Hydroquinone diacetate	124		97	16 6	118 2	171	286	82	153, 147	<i>bis</i> 317	
155	Methyl 3-nitro- cinnamate	124		207	199		-97	64 65	196		108 (cor ), al	
156	Methyl 3,5-dinitro- salicylate	127		242	182		-97	64 65	181, 173 (+1 H <sub>2</sub> O)		108 (cor ), al	
157	Methyl 4-hydroxy- benzoate	131		152	215, 210		-97	64 65	162 (+1 H <sub>2</sub> O), w	203-4, al	108 (cor ), al	
158	Methyl 3-nitro- salicylate	132		197	125 (+1 H <sub>2</sub> O)		-97	64 65	145		108 (cor ), al	
159	Triethyl trimesate	133		98	380 (cor )		-117 3	78 32	<i>tri</i> 365d (cor )		93, al	
160	Ethyl 4-nitro- cinnamate	137, 142		221	285		-117 3	78 32	204, 217		93, al	
161	Dimethyl terephthalate	141		97	300 (subl without melting)		-97	64 65	<i>di</i> >225		108 (cor ), al	
162	Tetramethyl pyromellitate	142		77 5	275		-97	64 65			108 (cor ), al	
163	Trimethyl trimesate	144		84	380 (cor )		-97	64 65	<i>tri</i> 365d (cor )		108 (cor ), al	
164	Di-4-tolyl oxalate (Di- "p-cresyl" oxalate)	148-9		135	189 5 (anh ), 101 (+2 H <sub>2</sub> O)		36	202	<i>mono</i> 219, <i>di</i> 419d	<i>mono</i> 169, <i>di</i> 268	188 6 (cor ), al	
165	Methyl 4-nitro- cinnamate	161		207	285		-97	64 65	204, 217		108 (cor ), al	
166	Diethyl mucate	163-4		133	214d , 223-55		-117 3	78 32	<i>mono</i> 192d , <i>di</i> 220		93, al	
167	Pyrogallol triacetate	165, 172		84	16 6	118 2	133	309	82	153, 147	<i>tri</i> 205	
168	Dimethyl mucate	165 7d		119	214d , 223-55		-97	64 65	<i>mono</i> 192d , <i>di</i> 220		108 (cor ), al	
169	Methyl gallate	200-1		184	253-4d , 222 40d		-97	64 65	189		108 (cor ), al	
170	Hydroquinone di- benzoate	204 (cor ), 199		159	122 4	249	171, 172	286	130	158	<i>bis</i> 317	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE XVII

*p*-Toluenesulfonamide (*p*-Toluenesulfonyl derivative).\*

From the amino acid in aqueous sodium hydroxide with *p*-toluenesulfonyl chloride in ether.

*For directions and examples see:* Cheronis, pp. 453-454; Linstead, pp. 77-78; Shriner, p. 231; Vogel, p. 437; Wild, pp. 169-170; E. Fischer and P. Bergell, *Chem. Ber.*, **35**, 3779, 3784 (1902); E. W. McChesney and W. K. Swann, *J. Amer. Chem. Soc.*, **59**, 1116 (1937).

From the amino acid in aqueous sodium hydroxide with *p*-toluenesulfonyl chloride.

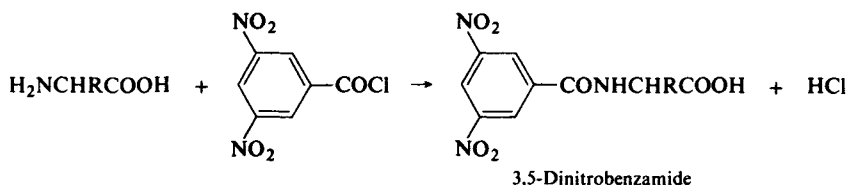
*See:* J. I. Harris and T. S. Work, *Biochem. J.*, **46**, 582 (1950).

From the amino acid with *p*-toluenesulfonyl chloride and triethylamine in aqueous tetrahydrofuran.

*See:* D. Theodoropoulos and L. C. Craig, *J. Org. Chem.*, **21**, 1376 (1956).

For an extensive list of references for the preparation of the *p*-toluenesulfonyl derivatives of amino acids *see:* J. P. Greenstein and M. Winitz, *Chemistry of the Amino Acids*, Vol. 2, John Wiley and Sons, New York, 1961, pp. 886-889.

## 3,5-Dinitrobenzamide (3,5-Dinitrobenzoyl derivative).\*



From the amino acid in aqueous sodium hydroxide with 3,5-dinitrobenzoyl chloride.

*For directions and examples see:* Cheronis, p. 453; Vogel, p. 436; Wild, p. 168; B. C. Saunders, *Biochem. J.*, **28**, 580 (1934); *J. Chem. Soc.*, 1397 (1938); B. C. Saunders, G. J. Stacey and I. G. E. Wilding, *Biochem. J.*, **36**, 368 (1942); B. W. Town, *Biochem. J.*, **35**, 578 (1941).

## Benzamide (Benzoyl derivative).



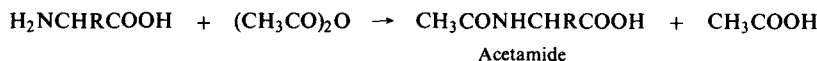
From the amino acid in aqueous sodium carbonate or bicarbonate and benzoyl chloride.

*For directions and examples see:* Linstead, p. 77; Vogel, p. 436; Wild, p. 167.

From the amino acid in aqueous sodium hydroxide with benzoyl chloride.

*See:* Cheronis, p. 453; E. Fischer and P. Bergell, *Chem. Ber.*, **35**, 3779, 3784 (1902); **39**, 597 (1906).

## Acetamide (Acetyl derivative).



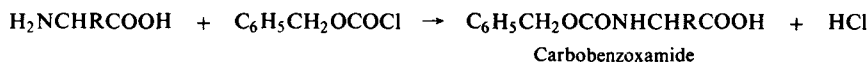
From the amino acid with acetic anhydride in water.

*For directions and examples see:* Linstead, p. 77; Shriner, p. 226; Wild, p. 167; R. M. Herbst and D. Shemin in *Organic Syntheses*, Coll. Vol. 2, (Ed. A. H. Blatt), John Wiley and Sons, New York, 1943, p. 11.

From the amino acid in aqueous sodium hydroxide with acetic anhydride.

*See:* Cheronis, p. 454; M. Bergmann and L. Zervas, *Biochem. Z.*, **203**, 288 (1928).

## Carbobenzoxamide (Carbobenzoxy derivative; Benzylloxycarbonyl derivative).



From the amino acid in aqueous sodium hydroxide with carbobenzoxy chloride (benzyl chloroformate).

*For directions and examples see:* M. Bergmann and L. Zervas, *Chem. Ber.*, **65**, 1192 (1932); M. Winitz, L. Bloch-Frankenthal, N. Izumiya, S. M. Birnbaum, C. G. Baker and J. P. Greenstein, *J. Amer. Chem. Soc.*, **78**, 2423 (1956).

\*Derivatives recommended for first trial.

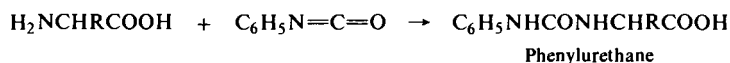
WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.



## EXPLANATIONS AND REFERENCES TO TABLE XVII (Continued)

For an extensive list of references for the preparation of the carbobenzoxy derivatives of amino acids see: J. P. Greenstein and M. Winitz, *Chemistry of the Amino Acids*, Vol. 2, John Wiley and Sons, New York, 1961, pp. 887-895.

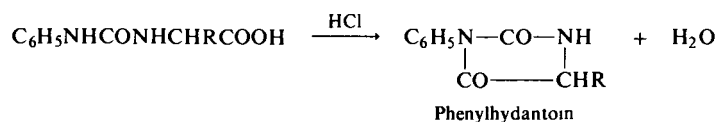
*Phenylurethane (Phenylurea derivative).\**



From the amino acid with aqueous potassium hydroxide and phenylisocyanate.

*For directions and examples see:* Linstead, p. 78; Shriner, p. 211; Wild, p. 171.

*Phenylhydantoin.\**



From the phenylurethane (obtained as described above) in aqueous hydrochloric acid.

*For directions and examples see:* Cheronis, p. 456.

*R<sub>f</sub> Values.*

For the determination of the *R<sub>f</sub>* values of amino acids in aqueous phenol, in collidine-lutidine and in butanol-acetic acid mixtures see: R. J. Block, R. LeStrange and G. Zweig, *Paper Chromatography*, Academic Press, New York, 1952, pp. 51-66; E. Lederer and M. Lederer, *Chromatography*, Elsevier Publishing Co., New York, 1957, pp. 306-311.

*NOTE:* For additional information regarding directions and examples for the preparation of derivatives of amino acids which are similar to those of amines (e.g., phenylurethane, acetamide, etc.) see explanations and references to Table XVIII, p. 291, 292, 293, 294.

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE XVII. ORGANIC DERIVATIVES OF AMINO ACIDS  
(Listed in order of increasing decomposition temperatures)\* \*\*

No	Name	Decomp temp °C	Specific rotation			Rf values***			<i>p</i> Toluene-sulfonyl	Phenyl urea	Benzoyl	3,5 Dinitro benzoyl	Picrate	Miscellaneous
			[α] <sub>D</sub>	T, °C	Conc (C) and solvent	Aqueous phenol	Collidine-Lutidine	Butanol-Ac acid						
1	3-Aminohydrocinnamic acid	84-5												Acetyl, 162, Hydrochloride, 191
2	N-Methyl-β-alanine	99-100												Hydrochloride, 105, aq al
3	Aminomalonic acid	109								61, pet eth				Formyl, 48, Heat → glycine decom temp 228 30 262
4	2-Aminophenylacetic acid	119								179, al				Acetyl, 158, Formyl, 110
5	2-Amino-1-Naphthoic acid	126												N-Acetyl, 195-6, al
6	N-Phenylglycine	127							195	63				Acetyl 124
7	4-Aminohydrocinnamic acid	132								194-5				Acetyl 143 (anh) 124 (hyd)
8	L-Ornithine	140	11.5	25	c = 6.5	0.79	0.11	0.15	190	240 (mono), 189 (di)			208	α,δ-Dicarbo-benzoyloxy, 112 4
9	Anthranilic acid (2-Amino benzoic acid)	147				0.85			217	181	182	278	104	
10	3-Aminophenylacetic acid	151												Amide, 164 6, al Chloroacetyl 187-8, al
11	5-Aminopentanoic acid (ω-Amino-n-valeric acid)	157									105 94			
12	2-Aminocinnamic acid	158, yel									191 3, al			Monoacetyl, 250 1, al, Diacetyl 158, lgr
13	DL-β-Amino-n-valeric acid DL-3-Amino pentanoic acid	160 5									145 6			N-β Naphthalenesulfonyl 134
14	2-Amino-4-toluc acid	165												Acetyl, 279-81
15	3-Aminobenzoic acid	174				0.86			270 264	248	270			
16	trans-4-Aminocinnamic acid	175-6								274				Acetyl, 259 60
17	ω-Aminotridecylic acid	177								111 105				Benzenesulfonyl, 120, al
18	3-Amino-4-toluc acid (Homoanthranilic acid)	177												Amide, 146, Acetyl, 184, Formyl, 186, al

\* Derivative data given in order m p, crystal color, solvent from which crystallized

\*\* Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

\*\*\* Aqueous phenol 80°, w/w for basic amino acids 3 vol —°, of a conc aq NH<sub>3</sub> has to be present (in a separate vessel) in the chamber, otherwise low values are obtained. Collidine-lutidine mixture 2,6-lutidine (100 ml), 2,4,6-collidine (100 ml), water (100 ml), diethylamine (3 ml), Butanol-acetic acid-water 40 ml 10 ml 10 ml

**TABLE XVII. ORGANIC DERIVATIVES OF AMINO ACIDS**  
(Listed in order of increasing decomposition temperatures)\* \*\* (Continued)

No	Name	Decomp temp °C	Specific rotation			Rf values***			<i>p</i> -Toluene-sulfonyl	Phenyl urea	Benzoyl	3,5-Dinitro benzoyl	Picrate	Miscellaneous
			[α] <sub>D</sub>	T °C	Conc (C) and solvent	Aqueous phenol	Collidine-Lutidine	Butanol-Ac acid						
19	4-Amino-1-naphthoic acid	177												Acetyl, 189, Amide, 175
20	<i>trans</i> -3-Amino-cinnamic acid	181, yel								229				Acetyl, 237, al
21	3-Amino-1-naphthoic acid	181												Acetyl, 254 5
22	N-Ethylglycine	182												Hydrochloride, ca 180
23	L-Canavanine	184	7.9	20		0.51				<i>tri</i> 186			163 4	
24	L-Glutamine	185				0.6								Carbo-benzyloxy, 137
25	Hippuric acid	187												4 Nitrobenzyl ester 136 4-Bromo phenacyl ester, 151
26	4-Aminobenzoic acid	188				0.81				300	278	290		
27	DL-Canaline	190-5									158 60 (di)			γ-Carbobenzyloxy, 208-10
28	Betaine (Tri-methyl-glycine)	193						0.43						Formyl, 183
29	DL-β-Amino-butyric acid	194				0.78					154			
30	DL-Glutamic acid	199				0.31	0.20	0.3	117		153 155			Acetyl, 187
31	4-Aminophenyl-acetic acid	199 200									205-6, al			Acetyl, 168 70, Chloroacetyl, 158-60
32	β-Alanine	200				0.66	0.22	0.37		168	120	202		Carbobenzyloxy, 106
33	L-Isoserine	200				0.39					107-9			
34	ω-Amino- <i>n</i> -caproic acid (6-Amino-hexanoic acid)	202									45-7			
35	γ-Aminobutyric acid	203				0.75								Hydrochloride, 135 Heat → pyrrolidone, 24, pet eth
36	DL-Proline	203 (mono-hyd)				0.88	0.28	0.43		170		217	135-7	
37	γ-Amino- <i>n</i> -caproic acid (4-Amino-hexanoic acid)	191 205-7									150 2			Hydrochloride, 120 1
38	6-Amino-1-naphthoic acid	205-6												Acetyl, 170 2, 252-3
39	1-Amino-2-naphthoic acid	205 r h												Heating with conc HCl → 1-naphthylamine, 50

\*Derivative data given in order m p, crystal color, solvent from which crystallized

\*\*Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

\*\*\*Aqueous phenol 80% w/w, for basic amino acids 3 vol --% of a conc aq NH<sub>3</sub> has to be present (in a separate vessel) in the chamber, otherwise low values are obtained, Collidine-lutidine mixture 2,6-lutidine (100 ml), 2,4,6-collidine (100 ml), water (100 ml), diethylamine (3 ml), Butanol-acetic acid-water 40 ml 10 ml 10 ml

TABLE XVII. ORGANIC DERIVATIVES OF AMINO ACIDS  
(Listed in order of increasing decomposition temperatures)\* \*\* (Continued)

No	Name	Decomp temp °C	Specific rotation			Rf values***			p-Toluene sulfonyl	Phenyl urea	Benzoyl	3,5-Dinitro benzoyl	Picrate	Miscellaneous
			[α] <sub>D</sub>	T °C	Conc (C) and solvent	Aqueous phenol	Collidine-Lutidine	Butanol-Ac acid						
40	L-Arginine	207	11.8	20	c = 0.87 in 0.5 N-NaOH	0.89	0.17	0.2			298 (mono), 235 (di)	150	217 (mono), 190 (di)	Monocarbo-benzyloxy, 175
41	L-Glutamic acid	211 r h, 197 s h	31.2	22.4	c = 3.48 in water	0.31	0.2	0.3	131					Acetyl, 199, Carboben-zyloxy, 120
42	5-Amino-1-naphthoic acid	212		18	c = 1.0 in 6N-HCl									Acetyl, 296, al
43	Sarcosine	212				0.78				102	104	153		Acetyl, 135
44	L-3,5-Di-iodo-tyrosine	213	2.9	20	c = 5.08 in 1.1 N-HCl	0.61	0.55							
45	L-α-Asparagine	213-5				0.47								Carboben-zyloxy, 164
46	DL-γ-Amino-n-valeric acid (DL-4-Amino-pentanoic acid)	214 (cor)									132			
47	L-Canaline	214				0.77					99 (di)		192.3	
48	β-Aminoiso-valeric acid	217												Hydrochloride, 120
49	β-Hydroxy-valine	218								182	153 (mono)			2-Naphthalene-sulfonyl, 261
50	L-Proline	220.2	-93.0	20	c = 2.42 in 0.6 N-KOH	0.88	0.28	0.43	130-3				154	Phenylhy-dantoin, 144
			-52.6	20	c = 0.57 in 0.5 N-HCl									
51	L-Citrulline	222	3.7	20	c = 2 in water	0.63	0.23	0.25					206	
52	7-Amino-1-naphthoic acid	223-4												Acetyl, 229
53	L-Lysine	224	14.6	20	c = 6.5 in water	0.81	0.11	0.14		184	235 (mono), 149 (di)		266	Monohydro-chloride 235
			25.9	22.9	c = 2.0 in 6 N-HCl									Dihydrochloride, 193 α,ε-Dicarboben-zyloxy, 150
54	β-L-Asparagine	227				0.40	0.21	0.19	175	164	189	196	180	Carboben-zyloxy, 165
55	3,5-Diamino-benzoic acid	228												3,5-Diacetyl, 184, Et ester, 84
56	L-Serine	228	14.45	25	c = 9.34 in 1 N-HCl	0.36	0.28	0.27						Carboben-zyloxy, 121
			-6.83	20	c = 10.4 in water									
57	Glycine	228.30, 262				0.41	0.24	0.26	147	197	187.5	179	202	Carboben-zyloxy, 120
58	DL-Thyroxine	230 s h, 250 r h				0.86	0.76				210.5			N-Chloro-acetyl, 201, Me ester 156
59	DL-β-Hydroxy-norvaline	230								156	170			Phenylhy-dantoin, 154.5

\*Derivative data given in order m p, crystal color, solvent from which crystallized

\*\*Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

\*\*\*Aqueous phenol 80% w/w, for basic amino acids 3 vol —% of a conc aq NH<sub>3</sub> has to be present (in a separate vessel) in the chamber, otherwise low values are obtained. Collidine-lutidine mixture 2,6-lutidine (100 ml), 2,4,6-collidine (100 ml), water (100 ml), diethylamine (3 ml), Butanol-acetic acid-water 40 ml 10 ml 10 ml

**TABLE XVII. ORGANIC DERIVATIVES OF AMINO ACIDS**  
(Listed in order of increasing decomposition temperatures)\* \*\* (Continued)

No	Name	Decomp temp, °C	Specific rotation			Rf values***			<i>p</i> -Toluene sulfonyl	Phenyl urea	Benzoyl	3,5-Dinitrobenzoyl	Picrate	Miscellaneous
			[α] <sub>D</sub>	T, °C	Conc (C) and solvent	Aqueous phenol	Collidine-Lutidine	Butanol-Ac acid						
60	DL-β-Amino-hydrocinnamic acid	231								194.6			Hydrochloride, 218, Formyl, 128-9, Acetyl, 161, al Amide, 266	
61	DL-Homo-aspartic acid (α-Amino-α-methyl succinic acid)	232												
62	D-β-Amino-hydrocinnamic acid	234-5	7.0	20	water								N-Formyl, 142-3	
63	L-β-Amino-hydrocinnamic acid	234-5	-7.5	25	water								N-Formyl, 142.3	
64	3-Amino-salicylic acid	235								189			Acetyl, 215, N-Benzenesulfonyl, 194	
65	DL-Allo-threonine	237				0.50	0.34				176 (mono), 174 (di)			
66	DL-Arginine	238				0.89	0.17	0.2			230 (di, anh), 176 (di, hyd)	200 (mono), 196 (di)		
67	4-Dimethyl-aminobenzoic acid	242											Amide, 206, Anilide, 182.3	
68	β-Amino-β-phenylisobutyric acid	243								205				
69	DL-Isoserine	246				0.39				184	151		Phenylurethane, 183-4	
70	DL-Serine	246				0.36	0.28	0.27	213	169	149-50		Carbobenzoyloxy, 125	
71	4-Hydroxy-phenylglycine	248									117		Monoacetyl, 203, Diacetyl, 174.5, Amide, 135	
72	Isoaspartic acid (α-Amino-α-methylmalonic acid)	250											Diamide, 200.1 Heat → alanine, 295 d	
73	DL-Threonine	251				0.50	0.34	0.35			177.8	145	Phenylhydantoin, 164	
74	DL-α-Amino-phenylacetic acid (subl)	256									175, al		Acetyl, 198.5, Formyl, 180	
75	L-Cystine	260	-214.4 -70.0	24.4 18.5	c = 1.0 in 1.02 N-HCl c = 0.4 in 0.2 N-NaOH			0.1	204.5	160	181 (di)	180	Dicarbonyloxy, 123	
76	DL-α-Amino-hydratropic acid (DL-α-Phenyl-alanine)	260											N-Carboethoxy, 191, al	

\* Derivative data given in order m p, crystal color, solvent from which crystallized

\*\* Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

\*\*\* Aqueous phenol 80% w/w for basic amino acids 3 vol —% of a conc aq NH<sub>3</sub> has to be present (in a separate vessel) in the chamber, otherwise low values are obtained. Collidine-lutidine mixture 2,6-lutidine (100 ml), 2,4,6-collidine (100 ml), water (100 ml), diethylamine (3 ml), Butanol-acetic acid-water 40 ml 10 ml 10 ml

TABLE XVII. ORGANIC DERIVATIVES OF AMINO ACIDS  
(Listed in order of increasing decomposition temperatures)\* \*\* (Continued)

No	Name	Decomp temp. °C	Specific rotation			Rf values***			<i>p</i> -Toluene-sulfonyl	Phenyl urea	Benzoyl	3,5 Dinitro benzoyl	Picrate	Miscellaneous
			[α] <sub>D</sub>	T °C	Conc (C) and solvent	Aqueous phenol	Collidine-Lutidine	Butanol Ac acid						
77	Glycylglycine	260				0.39		0.22	178	176	208	210		Carboben- zyloxy, 178
78	DL-β-Phenyl- alanine	264				0.85	0.48	0.68	134.5	182	188		173	Carboben- zyloxy, 103
79	DL-Aspartic acid	270 (>300)				0.19	0.21	0.24			119 (hyd), 176 (anh)			Carboben- zyloxy, 116
80	DL-α-Amino- octanoic acid	270				0.89	0.55				128			
81	L-Aspartic acid	270	24.6	24	c = 2.0 in 6 N HCl	0.19	0.21	0.24	140	162	185			Carboben- zyloxy, 116
82	DL-α-Amino- nonanoic acid	273									128			
83	L-Hydroxy- proline	274	-47.3	20	c = 1.31 in 1 N-HCl	0.63	0.28		153	175	100 (mono), 92 (di)			
			-75.2	22.5	c = 1.0 in water									
84	DL-Trypto- phane	275				0.75	0.50	0.50	176			240		N-Benzenesul- fonyl 185 Carboben- zyloxy, 169-70 1-Naphthyl- urea, 198
85	α-Aminoiso- butyric acid	280				0.74	0.32				198			
86	DL-α-Amino- heptanoic acid	281									135			
87	DL-Methionine	281				0.81	0.42	0.55	105		145			Acetyl, 114, Formyl, 100, Carboben- zyloxy, 112
88	5-Aminosalic- ylic acid	283									252			Monoacetyl, 218 Diacetyl, 184
89	DL-Lanthionine	283				0.26	0.11				195.8 (di)			
90	L-Methionine	283	-8.11	25	c = 0.8 in water	0.81	0.42	0.55				94.5 (hyd), 150 (anh)		Acetyl, 98.9 1-Naphthyl- urea, 188
91	L-(+)-Iso- leucine		40.6	20	c = 5.1 in 6.1 N-HCl	0.84	0.45	0.72	130-2	121	117			Formyl, 156
			11.29	20	c = 3.1 in water									
92	L-Phenylala- nine	283 320	-35.1	20	c = 1.94 in water	0.85	0.48	0.68	164	181	146	93		Carboben- zyloxy, 126.8
93	L-Hexahydro- tyrosine	285												N-4-Nitro- benzoyl, 225
94	D-(-)-Iso- leucine	285	-40.86	20	c = 4.53 in 6.1 N-HCl	0.84	0.45	0.72	130.2	121	117			Formyl, 156
95	L-Histidine	288, 253	13.0	22.7	c = 1.5 in 6 N-HCl	0.69	0.27	0.2	202.4		230 (mono)	189	86	Carboben- zyloxy, 209
			-39.0	25	c = 1.13 in water									
96	L-Cysteic acid	289 260	8.66	20	c = 1.85 g in 25 ml water									Diphenylacyl ester, 203

\* Derivative data given in order m p, crystal color, solvent from which crystallized

\*\* Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

\*\*\* Aqueous phenol 80%, w/w for basic amino acids 3 vol-% of a conc aq NH<sub>3</sub> has to be present (in a separate vessel) in the chamber. otherwise low values are obtained. Collidine-lutidine mixture 2,6-lutidine (100 ml), 2,4,6-collidine (100 ml), water (100 ml), diethylamine (3 ml) Butanol-acetic acid-water 40 ml 10 ml 10 ml

**TABLE XVII. ORGANIC DERIVATIVES OF AMINO ACIDS**  
(Listed in order of increasing decomposition temperatures)\* \*\* (Continued)

No	Name	Decomp temp. °C	Specific rotation			Rf values***			<i>p</i> -Toluene sulfonyl	Phenyl urea	Benzoyl	3,5-Dinitrobenzoyl	Picrate	Miscellaneous
			[α] <sub>D</sub>	T, °C	Conc (C) and solvent	Aqueous phenol	Collidine-Lutidine	Butanol-Ac acid						
97	L-Tryptophane	290 252	-31.5 6.17	22.7 20	c = 1.0 in water c = 2.42 in 0.5 N-NaOH	0.75	0.50	0.5	176	166	183	233		Carbobenzoyloxy, 126
98	DL-N-Methyl-α-alanine	292												Methylamide, 43, Hydrochloride, 110
99	DL-Isoleucine	292, 275 s h				0.84	0.45	0.72	141	120	118			Formyl, 121
100	L-(+)-α-Aminobutyric acid	292, 303 s h	18.65	19	c = 4.8 in 6 N-HCl	0.71	0.31	0.45			121			Formyl, 126, 1-Naphthylurea, 195
101	DL-Leucine	293, s h 332				0.84	0.45	0.73		165	137.41	187		
102	DL-α-Amino-α-methylvaleric acid (DL-α-Amino-α-methylpentanoic acid)	295, s h												1-Naphthylurea, 196
103	DL-Alanine	295				0.60	0.28	0.38	139		166	177		Carbobenzoyloxy, 114.5 Formyl, 194.5
104	D-α-Aminohydratropic acid	295 (subl)	70.0	18	water									
105	L-Alanine	297	14.7 2.7	15 22	c = 5.8 in 0.97 N-HCl c = 10.3 in water	0.60	0.28	0.38	133		151			Carbobenzoyloxy, 84 1-Naphthylurea, 220.2 Formyl, 114
106	DL-Norleucine	297 327				0.84	0.45	0.74	124					
107	DL-Valine	298, s h 282				0.78	0.36	0.6	110	164	132	158		
108	L-Djenkotic acid	300-50	-60.5 -47.5	20.5 25	1% in 1N-HCl 2% in 1N-HCl	0.40	0.13				166 (mono), 88 (di)			
109	D-N-Methyl-α-alanine	300	5.6	20	water									Hydrochloride, 165.6
110	Taurine	300-5				0.42								N-Me, 241, N-Et, 147
111	L-(+)-Norleucine	301	21.3 6.26	20 20	c = 4.25 in 6 N-HCl c = 0.7 in water	0.84	0.45	0.74			53			Formyl, 115-6, 2-Naphthalenesulfonyl, 149
112	DL-Norvaline	303, s h				0.80	0.39	0.65		117				Formyl, 132, Phenylhydantoin, 103
113	Creatine (α-Methylguanidoacetic acid)	303											218.20	Diacetyl, 165
114	4-Aminocyclohexanecarboxylic acid	303-4												Heat → lactam, 191-2

\*Derivative data given in order m p, crystal color, solvent from which crystallized

\*\*Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

\*\*\*Aqueous phenol 80% w/w for basic amino acids 3 vol —% of a conc aq NH<sub>3</sub> has to be present (in a separate vessel) in the chamber, otherwise low values are obtained. Collidine-lutidine mixture 2,6-lutidine (100 ml), 2,4,6-collidine (100 ml), water (100 ml), diethylamine (3 ml) Butanol-acetic acid-water 40 ml 10 ml 10 ml

TABLE XVII. ORGANIC DERIVATIVES OF AMINO ACIDS  
(Listed in order of increasing decomposition temperatures)\* \*\* (Continued)

No	Name	Decomp temp °C	Specific rotation			Rf values***			<i>p</i> Toluene sulfonyl	Phenyl urea	Benzoyl	3,5 Dinitro benzoyl	Picrate	Miscellaneous
			$[\alpha]_D$	T °C	Conc (C) and solvent	Aqueous phenol	Collidine-Lutidine	Butanol Ac acid						
115	DL- $\alpha$ -Aminobutyric acid	304				0.71	0.31	0.45		170	147			1-Naphthylurea, 194, Phthyl, 96
116	meso-Lanthionine	304				0.26	0.11				198-200			Dicarbo-benzyloxy, 139-40
117	Creatinine	305, 260											220	
118	L- $\alpha$ -Aminophenylacetic acid	305, 10	-111.0, -157	20, 20	water dil HCl									Acetyl 191, Formyl 190
119	meso-2,3-Diaminosuccinic acid	306										(di) 212 hyd		Diacetyl, 235
120	L-(+)-Norvaline	307	23.0	20	c = 10 in 10% HCl	0.80	0.39				64			Acetyl, 137
121	L-Tyrosine	314-8 r h, 290.5 s h	-8.64, -13.2	20, 18	c = 4.4 in 6.3 N HCl, c = 0.91 in 3 N-NaOH	0.51	0.51	0.45	N- 188	104	N- 166, 7, 211, 2 (di)			N-Acetyl, 148, Diacetyl, 172, N-Carbobenzyloxy, 101
122	L-(+)-Valine	315	28.8	20	c = 3.4 in 6 N-HCl	0.78	0.36	0.60	147		127	157.8		Carbobenzyloxy, 64-5
123	L-Leucine	337	15.1, -10.8	25.9, 24.7	c = 2.0 in 6 N-HCl, c = 2.0 in water	0.84	0.45	0.73	124	115	118	187		
124	DL-Tyrosine	340 r h, 295 s h, 350, 320 s h				0.51	0.51	0.45	224.6		N- 197	252.4 (di)		
125	1-Aminocyclohexanecarboxylic acid	350, 320 s h											209-10	Hydrochloride, 310
126	DL-2,3-Diaminosuccinic acid										164 (di) hyd			Diacetyl, 235
127	DL-Ornithine					0.79	0.11	0.15	188 (mono)	192	4 N, 285-8, 188 (di)		208 (di)	
128	L-(+)-Alloisoleucine		38.1	20	c = 3.97 in 6 N-HCl					151				Formyl, 126, 1-Naphthylurea, 166, Benzene-sulfonyl, 147
129	DL-Lysine					0.81	0.11	0.14		196	249 (mono), 146 (di)		225 (mono)	Monohydrochloride, 260.3, Dihydrochloride, 187-9
130	L-Cysteine					0.57								S-Benzyl, 216, Oxid $\rightarrow$ L-cystine, 260 d Hydrochloride, 175-8, $[\alpha]_D^{25}$ 9.5 (c = 2 in water)

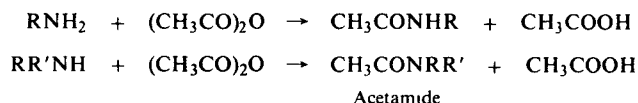
\*Derivative data given in order m p, crystal color, solvent from which crystallized

\*\*Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

\*\*\*Aqueous phenol 80°, w/w for basic amino acids 3 vol —°, of a conc aq NH<sub>3</sub>, has to be present (in a separate vessel) in the chamber otherwise low values are obtained. Collidine-lutidine mixture 2.6-lutidine (100 ml) 2.4-collidine (100 ml), water (100 ml) diethylamine (3 ml) Butanol-acetic acid-water 40 ml 10 ml 10 ml



## EXPLANATIONS AND REFERENCES TO TABLE XVIII

*Acetamide (Acetyl derivative) \***For primary and secondary amines only*

From the amine with acetic anhydride without solvent

*For directions and examples see* Cheronis, pp 591-593, Linstead, p 60, Vogel, p 652, Wild, p 218, J J Sudborough, *J Chem Soc*, **79**, 533 (1901), L C Raiford, R Taft and H P Lankelma, *J Amer Chem Soc*, **46**, 2051 (1924)

From the amine with acetic anhydride in aqueous sodium hydroxide

*See* F D Chattaway, *J Chem Soc*, 2495 (1931)

From the amine with acetic anhydride in pyridine

*See* Cheronis, pp 590, 592-593

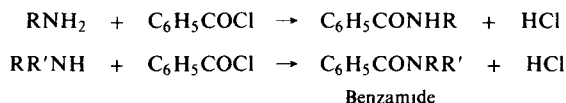
From the amine hydrochloride with acetic anhydride in aqueous sodium acetate

*See* Linstead, p 60, Vogel, p 652

From the amine with acetic anhydride in water

*See* Shriner, p 226

From the amine with acetic anhydride in acetic acid

*See* Wild, p 218*Benzamide (Benzoyl derivative) \***For primary and secondary amines only*

From the amine with benzoyl chloride in aqueous sodium hydroxide

*For directions and examples see* Cheronis, pp 591, 593-594, Linstead, p 60, Vogel, p 652, Wild, p 219

From the amine with benzoyl chloride in a pyridine-benzene mixture

*See* Shriner, p 226

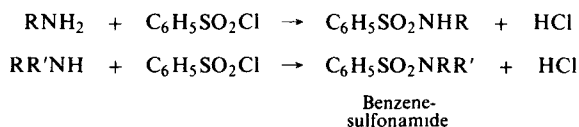
From the amine with benzoyl chloride in benzene

*See* Shriner, p 227

From the amine with benzoyl chloride in an aqueous sodium hydroxide-chloroform mixture

*See* Shriner, p 226

From the amine with benzoyl chloride

*See* Vogel, p 653*Benzenesulfonamide (Benzenesulfonyl chloride derivative) \***For primary and secondary amines only*

From the amine with benzenesulfonyl chloride in aqueous sodium hydroxide

*For directions and examples see* Cheronis, pp 595-596, Shriner, pp 103-104, Vogel, p 653, O Hinsberg, *Chem Ber*, **23**, 2962 (1890), **38**, 906 (1905)

From the amine in aqueous sodium hydroxide with benzenesulfonyl chloride in methanol

*See* Cheronis, p 596

From the amine with benzenesulfonyl chloride in benzene

*See* Wild, p 221

From the amine in aqueous sodium hydroxide with benzenesulfonyl chloride in acetone

*See* Wild, p 221

From the amine with benzenesulfonyl chloride in aqueous pyridine

*See* Wild, p 221

From the amine with benzenesulfonyl chloride in pyridine

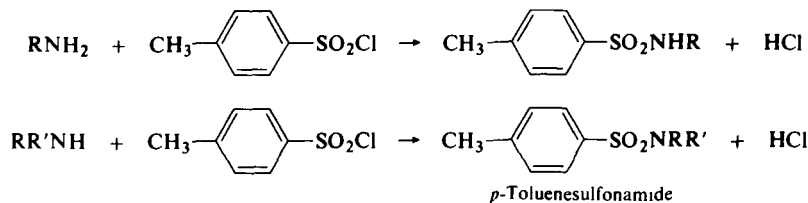
*See* Vogel, p 653**\*Derivatives recommended for first trial****WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLE XVIII (Continued)

From the amine with benzenesulfonyl chloride in aqueous sodium hydroxide

See Wild, p 221

*p*-Toluenesulfonamide (*p*-Toluenesulfonyl chloride derivative) \*



*For primary and secondary amines only*

From the amine with *p*-toluenesulfonyl chloride in aqueous sodium hydroxide

*For directions and examples see* Cheronis, p 595, Linstead, p 60, Shriner, pp 103 104, Vogel, p 653

From the amine with *p*-toluenesulfonyl chloride in benzene

See Wild, p 221

From the amine with *p*-toluenesulfonyl chloride in acetone

See Wild, p 221

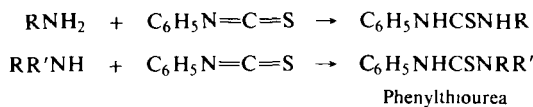
From the amine with *p*-toluenesulfonyl chloride in pyridine

See F Bell, *J Chem Soc*, 2787 (1929)

From the amine with *p*-toluenesulfonyl chloride in aqueous pyridine

See Wild, p 221

Phenylthiourea \*



*For primary and secondary amines only*

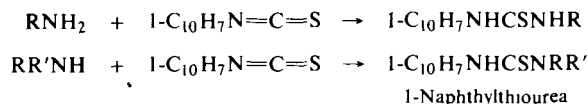
From the amine with phenylisothiocyanate in alcohol

*For directions and examples see* Cheronis, pp 599-600, Shriner, p 227, Vogel, p 422, Wild, p 227, T Otterbacher and F C Whitmore, *J Amer Chem Soc*, 51, 1909 (1929)

From the amine with phenylisothiocyanate without solvent

See Vogel, p 422, Wild, p 227, N A Lange, H L Ebert and L K Youse, *J Amer Chem Soc*, 51, 1911 (1929)

1-Naphthylthiourea \*



*For primary and secondary amines only*

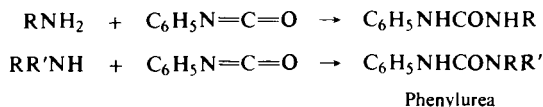
From the amine with 1-naphthylisothiocyanate in ethanol

*For directions and examples see* Cheronis, pp 600-601, Vogel, p 422, Wild, p 227, C M Suter and E W Moffet, *J Amer Chem Soc*, 55, 2497 (1933)

From the amine with 1-naphthylisothiocyanate without solvent

See Vogel, p 422, Wild, p 227, C M Suter and E W Moffett, *J Amer Chem Soc*, 55, 2497 (1933)

Phenylurea



*For primary and secondary amines only*

From the amine with phenylisocyanate in petrol ether

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

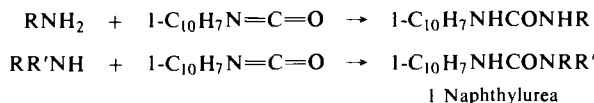
## EXPLANATIONS AND REFERENCES TO TABLE XVIII (Continued)

For directions and examples see Linstead, p 61, Wild, pp 223 224

From the amine with phenylisocyanate without solvent

See N A Lange, H L Ebert and L K Youse, *J Amer Chem Soc*, **51**, 1911 (1929)

### 1-Naphthylurea \*



For primary and secondary amines only

From the amine with 1-naphthylisocyanate without solvent

For directions and examples see Cheronis, p 599, H E French and A F Wirtel, *J Amer Chem Soc*, **48**, 1736 (1926)

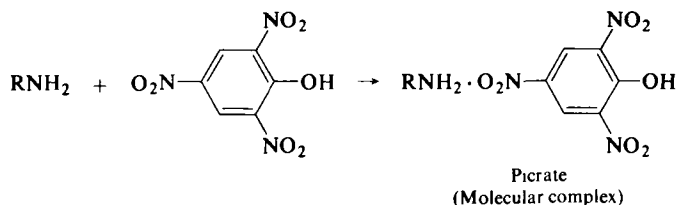
From the amine with 1-naphthylisocyanate in petrol ether

See Linstead, p 61, Wild, pp 223 224

From the amine with 1-naphthylisocyanate with water

See Wild, p 224

### Picrate \*



For primary, secondary and tertiary amines

From the amine with picric acid in methanol or in ethanol

For directions and examples see Cheronis, pp 603 604, Linstead, p 50, 61, Shriner, p 229, Vogel, pp 422-423, Wild, p 212

From the amine with picric acid in water

See Vogel, p 422

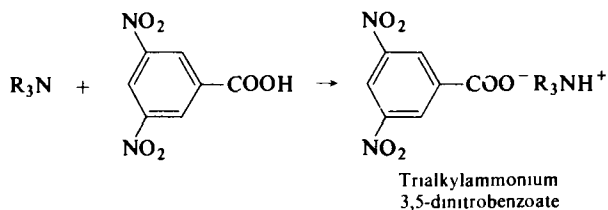
From the amine with picric acid in acetone or benzene

See Wild, p 212

From the amine with picric acid

See Shriner, p 229

### 3,5-Dinitrobenzoic acid salt \*

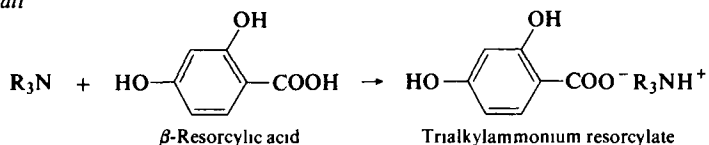


Especially for tertiary amines

From the amine with 3,5-dinitrobenzoic acid in methanol or ethanol

For directions and examples see Cheronis, pp 602 603, Wild, p 215, C A Buehler, E J Currier and R Lawrence, *Ind Eng Chem, Anal Ed*, **5**, 277 (1933), C A Buehler and J D Calfree, *Ind Eng Chem, Anal Ed*, **6**, 351 (1934)

### $\beta$ -Resorcylic acid salt



\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

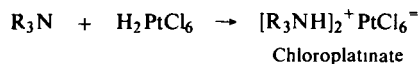
## EXPLANATIONS AND REFERENCES TO TABLE XVIII (Continued)

*Especially for tertiary amines.*

From the amine with  $\beta$ -resorcylic acid in ether.

*For directions and examples see:* Cheronis, p. 603; K. W. Wilson, F. E. Anderson and R. W. Donohoe, *Anal. Chem.*, **23**, 1032 (1951).

*Chloroplatinic acid salt.\**

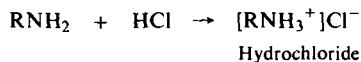


*Especially for tertiary amines.*

From the amine in aqueous hydrochloric acid with aqueous chloroplatinic acid.

*For directions and examples see:* Shriner, p. 230; Wild, p. 213.

*Hydrochloride.*



*For primary, secondary and tertiary amines.*

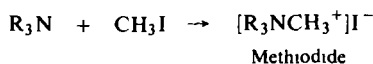
From the amine with gaseous hydrogen chloride in ether, benzene or chloroform.

*For directions and examples see:* Cheronis, p. 601; Shriner, p. 224; Wild, p. 211.

From the amine with dilute aqueous hydrochloric acid.

*See:* Wild, p. 211.

*Methiodide.\**



*Especially for tertiary amines.*

From the amine with methyl iodide without solvent.

*For directions and examples see:* Linstead, p. 61; Shriner, p. 228; Vogel, p. 660; Wild, p. 232.

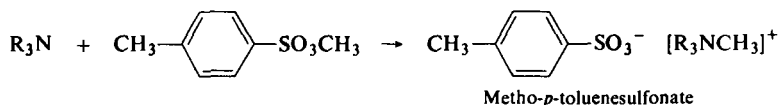
From the amine with methyl iodide in isopropyl ether.

*See:* Cheronis, p. 604.

From the amine with methyl iodide in ether or benzene.

*See:* Vogel, p. 660.

*Metho-*p*-toluenesulfonate (Methyl *p*-toluenesulfonate).\**



*Especially for tertiary amines.*

From the amine with methyl *p*-toluenesulfonate in isopropyl ether.

*For directions and examples see:* Cheronis, p. 604.

From the amine with methyl *p*-toluenesulfonate in benzene.

*See:* Linstead, p. 62; Shriner, p. 229; Vogel, p. 660; Wild, p. 233; C. S. Marvel, E. W. Scott and K. L. Amstutz, *J. Amer. Chem. Soc.*, **51**, 3638 (1929).

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	Melting point, °C	$n_D$	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
1	Methylamine	-6			0.699 <sub>4</sub> <sup>11</sup>	28	80	30	75	113	207, 215	
2	Dimethylamine	7			0.680 <sub>4</sub> <sup>9</sup>		41	47	79	135	158	
3	Ethylamine	16.5			0.7057 <sub>4</sub> <sup>9</sup>		71	58	63	106	165	
4	Isopropylamine	19 33		1.377 <sup>15</sup>	0.691 <sub>4</sub> <sup>18</sup>			26		135 101		1-Naphthylurea, 200, 1-Naphthylthiourea, 143
5	Ethyl methyl amine	36									196	Chloroplatinate, 207, Hydrochloride, 126-30
6	<i>tert</i> -Butylamine	46		1.3794 <sup>18</sup>	0.7004 <sup>15</sup>	101.2	134			120	198	Hydrochloride, 270-80
7	<i>n</i> -Propylamine	49		1.3901 <sup>17</sup>	0.714 <sub>4</sub> <sup>25</sup>		84	36	52	63	135	1-Naphthylurea, 196
8	Isopropyl methyl amine	50			0.7026 <sub>4</sub> <sup>19</sup>					120	135	Phenylurea, 131
9	Cyclopropylamine	50		1.421 <sup>20</sup>	0.824 <sub>4</sub> <sup>20</sup>		99	120 ( <i>dt</i> )			149	Hydrochloride, 100
10	Ethyleneimine	56			0.832 <sub>4</sub> <sup>24</sup>				52		142	Oxalate, 115
11	Diethylamine	56		1.3873 <sup>18</sup>	0.7108 <sub>4</sub> <sup>18</sup>		42	42	60	34	155	1-Naphthylthiourea, 108
12	Allylamine	58		1.4194 <sup>22</sup>	0.7436 <sub>4</sub> <sup>20</sup>			39	64	98	140	
13	DL- <i>sec</i> - <i>n</i> -Butylamine (2-Aminobutane)	63		1.395 <sup>17</sup>	0.718 <sub>4</sub> <sup>20</sup>		76	70	55	101	139.40	
14	<i>unsym</i> -Dimethylhydrazine	63		1.4075 <sup>22</sup>	0.7914 <sup>22</sup>							Hydrochloride, 81-2, Oxalate, 142, Sulfate, 105
15	Trimethyleneimine (Azetidene)	63		1.4287 <sup>24</sup>	0.8436 <sub>4</sub> <sup>20</sup>						166-7	Chloroplatinate, 203, Chloroaurate, 192
16	Isobutylamine	69		1.3988 <sup>17</sup>	0.724 <sub>4</sub> <sup>25</sup>		57	53	78	82	150	
17	<i>n</i> -Butylamine	77		1.401	0.7401 <sub>4</sub> <sup>20</sup>					65	151	1-Naphthylurea, 149, 1-Naphthylthiourea, 108-9, Hydrochloride, 195
18	2-Amino-2-methylbutane	78			0.756 <sub>4</sub> <sup>9</sup>						183	
19	DL- <i>sec</i> -Butyl methyl amine	78.9			0.740 <sub>4</sub> <sup>15</sup>						78	Chloroplatinate, 151
20	Ethyl propyl amine	80.1		1.3966	0.773 <sub>4</sub> <sup>24</sup>							Hydrochloride, 225, Chloroplatinate, 198, Chloroaurate, 86
21	<i>Sym</i> -Dimethylhydrazine	81		1.4209 <sup>20</sup>	0.8274 <sub>4</sub> <sup>20</sup>						147.50	Oxalate, 119, Hydrochloride, 168
22	Cyclobutylamine	82		1.4363 <sup>19</sup>	0.8328 <sub>4</sub> <sup>20</sup>							Chloroplatinate, 210.5
23	Di-isopropylamine	84			0.722 <sub>4</sub> <sup>22</sup>						140	N-Nitroso, 48, Chloroplatinate, 186.9, Hydrochloride, 216-7
24	Pyrrolidine	89		1.4270 <sup>15</sup>	0.852 <sub>4</sub> <sup>22</sup>				123		112, yel., 163-4, red	
25	<i>n</i> -Butyl methyl amine	90-1		1.4018 <sup>18</sup>	0.7367 <sub>4</sub> <sup>15</sup>						111	Hydrochloride, 170, Chloroplatinate, 205
26	5-Amino-1-pentene	91-4										Chloroplatinate, 166, Chloroaurate, 195
27	DL-2-Amino- <i>n</i> -pentane ( <i>sec</i> - <i>n</i> -Amylamine)	92			0.7384 <sub>4</sub> <sup>20</sup>							Hydrochloride, 168, Oxalate, 226, 131
28	Isoamylamine	96		1.4096 <sup>18</sup>	0.751 <sub>4</sub> <sup>18</sup>					102	138	Chloroaurate, 82-3 1-Naphthylurea, 132

\*Derivative data given in order m.p., crystal color, solvent from which crystallized.

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point, °C	$n_D$	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
29	D-2-Methyl- <i>n</i> -butylamine ( <i>active</i> -Amylamine)	96			0.7505 <sup>25</sup> <sub>4</sub>							[ $\alpha$ ] <sub>D</sub> <sup>20</sup> -5.86, Hydrochloride, 176, Chloroplatinate, 240
30	2-Methylpyrrolidine	97.8			0.84 <sup>20</sup> <sub>20</sub>						88.5 9.5	Oxalate, 178.9, Chloroplatinate, 172.3 (anh.), 206-7, rapid htng. Picrate of <i>N</i> -methyl deriv., 235
31	3-Methylpyrrolidine	103.5		1.4480 <sup>20</sup>	0.8654 <sup>0</sup> <sub>4</sub>						106	Chloroplatinate, 194
32	<i>n</i> -Amylamine	104			0.7614 <sup>20</sup> <sub>4</sub>					69	139	2-Naphthylthiourea, 114
33	2-(Methylamino)- <i>n</i> -pentane	105			0.947 <sup>20</sup>						77.8	Chloroplatinate, 138
34	Piperidine	106		1.4530 <sup>20</sup>	0.8606 <sup>20</sup> <sub>4</sub>	48		93.4	96	101	152	
35	2-Aminodiethylether	108.9		1.4101 <sup>20</sup>	0.8512 <sup>20</sup> <sub>4</sub>						122	Picrolonate, 204
36	Di- <i>n</i> -propylamine	109.10		1.4046 <sup>20</sup>	0.7384 <sup>20</sup> <sub>4</sub>			51		69	75	1-Naphthylurea, 93
37	2,5-Dimethylpyrrolidine	110.3		1.4357 <sup>15</sup>	0.8185 <sup>1,2</sup> <sub>4</sub>						117.8	Hydrochloride, 188.90, Chloroplatinate, 225
38	2,4-Dimethylpyrrolidine	115.7		1.4325 <sup>20</sup>	0.8297 <sup>20</sup> <sub>4</sub>						116.7	Chloroplatinate, 210
39	1,2-Ethylenediamine	116	8.5	1.454 <sup>26</sup>	0.898 <sup>25</sup> <sub>4</sub>	172 ( <i>di</i> )	244 ( <i>di</i> )	168 ( <i>di</i> )	360 ( <i>di</i> )	102	233 ( <i>di</i> )	
40	L-2-Methylpiperidine	117	50.1								116.7	Hydrochloride, 190, Chloroplatinate, 194
41	DL-2-Methylpiperidine	118-9		1.4464 <sup>24</sup>	0.8436 <sup>24</sup> <sub>4</sub>		45		55		164	Hydrochloride, 207, Oxalate, 125
42	DL-1,2-Diaminopropane	119-20			0.878 <sup>15</sup>	139 ( <i>di</i> )	192 ( <i>di</i> )				135 ( <i>di</i> )	
43	Isohexylamine	125			0.758 <sup>25</sup> <sub>4</sub>						123.5	Hydrochloride, 220, Oxalate, 166, Chloroplatinate, 200
44	DL-3-Methylpiperidine	126		1.446 <sup>24</sup>	0.845 <sup>24</sup> <sub>4</sub>						138 ( <i>di</i> )	Hydrochloride, 172, N-2,4-Dinitrophenyl deriv., 67
45	2,6-Dimethylpiperidine	127-8		1.4366 <sup>25</sup>	0.816 <sup>25</sup> <sub>4</sub>		111	50			162.4	Chloroplatinate, 212
46	<i>n</i> -Hexylamine	130	-19		0.763 <sup>25</sup> <sub>4</sub>		40	96		77	126	
47	3-Amino- <i>n</i> -hexane	130										Hydrochloride, 227, Chloroplatinate, 190-200
48	Morpholine	130					75	118	147	136	146	
49	Cyclohexylamine	134		1.4372 <sup>20</sup>	0.8191 <sup>20</sup> <sub>4</sub>	101	149	89		148		
50	Trimethylenediamine (1,3-Diaminopropane, 1,3-Propylenediamine)	136			0.884 <sup>25</sup> <sub>4</sub>	1,3- <i>di</i> 126, 107	1,3- <i>di</i> 140, 147	96	148		250	Chloroplatinate, 240
51	2,2,6-Trimethylpiperidine	138.9									195.6	Hydrochloride, 236, Chloroaurate, 128
52	Di-isobutylamine	139	-77	1.4093 <sup>20</sup>	0.745 <sup>20</sup> <sub>4</sub>	86		55, 57		113	121	
53	4-Amino- <i>n</i> -heptane	139.40			0.767 <sup>20</sup> <sub>4</sub>							Hydrochloride, 246-7, Chloroplatinate, 235
54	1,3-Diaminobutane	141.2									240-5	Hydrochloride, 171.2
55	2-Amino- <i>n</i> -heptane	142		1.4199 <sup>19</sup>	0.7665 <sup>19</sup> <sub>4</sub>							Hydrochloride, 133, Oxalate, 204-5, Chloroaurate, 63.4
56	<i>unsym</i> -Diethylethylenediamine	145			0.827 <sup>19</sup> <sub>19</sub>					115 ( <i>mono</i> ), 211 ( <i>di</i> )		Chloroplatinate, 211
57	Furfurylamine ( $\alpha$ -Furylmethylamine)	145.6									150	Oxalate, 145, With CO <sub>2</sub> from air $\rightarrow$ comp., 75, Hydrochloride, 110

\* Derivative data given in order:  $n_D$ , crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	$n_D$	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
58	Cyclohexyl methyl amine	145.7					85-6				170	Hydrochloride, 193
59	2-Ethylpiperidine ( $\alpha$ -Ethylpiperidine)	146.7			0.8651 <sub>0</sub>			64-5			133	Hydrochloride, 181, Chloroplatinate, 202
60	2,2,4-Trimethylpiperidine	148			0.832 <sup>15</sup>							Chloroplatinate, 215, Methiodide, 266
61	Sym-Diethylethylenediamine	149.50										Hydrochloride, 260, Chloroplatinate, 223, Chloraurate, 220
62	4-Ethylpiperidine ( $\gamma$ -Ethylpiperidine)	151		1.4503 <sup>25</sup>	0.876 <sup>0</sup>			74-5				Chloroplatinate, 173, Chloraurate, 105
63	3-Ethylpiperidine ( $\beta$ -Ethylpiperidine)	153			0.871 <sub>4</sub> <sup>16</sup>						63	Hydrochloride, 141, Chloroplatinate, 183
64	<i>n</i> -Heptylamine	155	-23	1.41954 <sub>26</sub> <sup>26</sup>	0.777 <sup>20</sup>					75	121	1-Naphthylthiourea, 68.9
65	Di- <i>n</i> -butylamine	159								86	59	1-Naphthylthiourea, 123
66	Tetramethylenediamine (1,4-Diaminobutane, Putrescine)	159	27		0.877 <sub>4</sub> <sup>25</sup>	137 ( <i>di</i> )	177 ( <i>di</i> )		224 ( <i>di</i> )		249-50 ( <i>di</i> )	
67	DL-2-Hydroxy- <i>n</i> -propylamine (Isopropanolamine)	163			0.973 <sup>18</sup>						142	Chloroplatinate, 195, Hydrochloride, 73
68	Hexahydrobenzylamine	163.5		1.4646 <sup>18</sup>	0.87 <sub>4</sub> <sup>20</sup>		98, 107				184.6	Hydrochloride, 254
69	Cyclohexyl ethyl amine	164			0.868 <sub>0</sub>						133	Hydrochloride, 184
70	2-Ethylcyclohexylamine	170.1		1.4682 <sup>20</sup>	0.8744 <sub>20</sub> <sup>20</sup>			121-2			190	Chloroplatinate, 239
71	2-Aminoethyl alcohol (Ethanolamine)	171		1.4539 <sup>20</sup>	1.022 <sub>4</sub> <sup>20</sup>						160	1-Naphthylurea, 186
72	3-Amino-2-hydroxypentane	172			0.906 <sup>18</sup>							N-Chloroacetyl deriv., 52.60, Monooxalate, 166, Dioxalate, 204
73	2-Aminopropyl alcohol	173-6										Hydrochloride, 86, Chloroplatinate, 198.9
74	2-Amino-3-hydroxypentane	174		1.4458	0.9289 <sup>24</sup>							Chloroplatinate, 154, Picronate, 215
75	2-Fluoroaniline	176	-35 -29			80	113					Picrate of N,N-dimethyl deriv., 131
76	Pentamethylenediamine (1,5-Diaminopentane, Cadaverine)	178.80			0.9174 <sub>0</sub>		135 ( <i>di</i> )	119		148	237	
77	<i>n</i> -Octylamine	180			0.777 <sup>20</sup>							1-Naphthylthiourea, 72
78	5-Methyl-2-pyrazoline	180					156				126	Phenylurea, 127
79	Benzyl methyl amine	181			0.945 <sub>15</sub> <sup>18</sup>				95		117-8	Chloroplatinate, 197
80	Aniline	184		1.5863 <sup>20</sup>	1.022 <sub>4</sub> <sup>20</sup>	114	160	112	103	54	180	
81	Benzylamine	184-5		1.5401	0.9826 <sub>4</sub> <sup>19</sup>	65	105	88	116, 185	156	194	
82	4-Fluoroaniline	186	-1	1.5195 <sup>20</sup>	1.1725 <sub>0</sub> <sup>20</sup>	152	185					N-4-Nitrobenzoyl deriv., 181
83	DL- $\alpha$ -Phenylethylamine ( $\alpha$ -Aminoethylbenzene)	187, 185			0.9395 <sup>15</sup>	57	120					Hydrochloride, 158
84	1,2-Diaminocyclohexane	187				260 ( <i>di</i> )					210.5 ( <i>di</i> )	Hydrochloride, 280
85	3-Fluoroaniline	187-8, yel			1.160 <sup>16</sup>	84						
86	Di-isoamylamine	187-8	-44	1.4229 <sup>21</sup>	0.7672 <sub>4</sub> <sup>21</sup>					72	94.5	1-Naphthylurea, 95, Methiodide, 221
87	3-Aminopropyl alcohol	188		1.457 <sup>26</sup>	0.982 <sub>6</sub> <sup>26</sup>						222	Chloroplatinate, 199

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	$n_D$	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
88	1,2,3-Triaminopropane	190				200-2 ( <i>tri</i> )	217-8 ( <i>tri</i> )				>269	
89	4-Amino-2,6-dimethylpiperidine	195									220	Chloroplatinate, >250
90	N-Methylaniline	196		1.573 <sup>16</sup>	0.989 <sup>20</sup> <sub>4</sub>	102	63	79	94	87	145	
91	1-Phenylisopropylamine	196-7		1.5181 <sup>25</sup>	0.9424 <sup>20</sup> <sub>6</sub>		159					Oxalate, 131, Hydrochloride, 236
92	$\beta$ -Phenylethylamine ( $\beta$ -Aminoethylbenzene)	198			0.958 <sup>24</sup> <sub>4</sub>	51	116	69		135	174, 167	
93	Benzyl ethyl amine	199			0.935 <sup>17</sup> <sub>15</sub>				50		118	Hydrochloride, 184
94	2-Methylaniline ( <i>o</i> -Toluidine)	200		1.5688 <sup>20</sup>	1.0053 <sup>20</sup> <sub>30</sub>	110-1	146	124	185.6	136	213	
95	<i>n</i> -Nonylamine	201				34-5	49				111	
96	3-Methylaniline ( <i>m</i> -Toluidine)	203		1.5686 <sup>20</sup>	0.990 <sup>25</sup> <sub>25</sub>	65	125	95	171-2		200	
97	Di- <i>n</i> -amylamine	205								72		2-Naphthylthiourea 126, Hydrochloride, 275
98	DL-2-Phenylisopropylamine	205				64 initially, 93 on standing					143	Hydrochloride 145-7
99	N-Ethylaniline	205		1.5559 <sup>20</sup>	0.9625 <sup>20</sup> <sub>20</sub>	54	60		87	89	132, 138	
100	4-Methylpyrazole	207		1.4920 <sup>20</sup> <sub>He</sub>	1.015 <sup>20</sup>						142	1- <i>o</i> -Nitrobenzoyl deriv., 107
101	3-Methylbenzylamine ( <i>m</i> -Xylylamine)	207			0.9654 <sup>20</sup> <sub>6</sub>	235-40	150				198, 156	Hydrochloride, 208 Chloroplatinate, 214
102	2-Chloroaniline	209-207		1.5895 <sup>20</sup>	1.2125 <sup>20</sup> <sub>20</sub>	87	99	129	193, 105	156	134	
103	N,2-Dimethylaniline (N-Methyl- <i>o</i> -toluidine)	208			0.973 <sup>15</sup>	56	66				90	
104	2-Methylbenzylamine ( <i>o</i> -Xylylamine)	208	-20	1.5436 <sup>19</sup>	0.977 <sup>18</sup> <sub>8</sub>	69	88				215	Chloroplatinate, 220-3
105	4-Methylbenzylamine ( <i>p</i> -Xylylamine)	208	13	1.5364 <sup>20</sup>	0.952 <sup>20</sup> <sub>20</sub>	107-8	137				204	
106	3-Methylpyrazole	208		1.497 <sup>18</sup> <sub>He</sub>	1.020 <sup>18</sup>	29-30					144	N- <i>o</i> -Nitrobenzoyl deriv., 120
107	1-Phenylpropylamine	208		1.5173 <sup>25</sup>	0.9347 <sup>25</sup> <sub>25</sub>		115-6	81				Hydrochloride, 190
108	2-Phenylpropylamine	210					85				182	Hydrochloride, 123-4
109	N,4-Dimethylaniline (N-Methyl <i>p</i> -toluidine)	210				83		67			131	N-Nitroso deriv., 52, Hydrochloride, 119-5
110	2-Ethylaniline	210-11	46-6	1.5584 <sup>22</sup>	0.9810 <sup>20</sup>	111	147				194-5	
111	L-Menthylamine	212, 207				145	156			135	215	$[\alpha]_D^{20}$ -34.2
112	2,5-Dimethylaniline ( <i>p</i> -2-Xyldine)	213-5, pale yellow	14-2	1.5591 <sup>21</sup>	0.9735 <sup>20</sup>	139	140	138	232-3, 119	148	171	
113	1-Phenylisobutylamine	214		1.5123 <sup>20</sup>	0.920 <sup>20</sup> <sub>20</sub>						166-8	Oxalate, 120-2, Hydrochloride, 275-7
114	3-Methylpyridazine	215			1.0486 <sup>28</sup> <sub>28</sub>						143-4	
115	2,6-Dimethylaniline ( <i>m</i> -2-Xyldine)	215, 218	11-2	1.5610 <sup>20</sup>	0.9842 <sup>20</sup>	177	168		212	204	180	
116	4-Ethylaniline	216, 214	-6	1.5550 <sup>20</sup>	0.9690 <sup>20</sup>	94	151		104			
117	2,4-Dimethylaniline ( <i>m</i> -4-Xyldine)	217		1.561 <sup>20</sup>	0.9783 <sup>20</sup> <sub>20</sub>	133, 130	192	130	181	152	209	
118	2-Chloro-N-methylaniline	218			1.1735 <sup>11</sup>						133	
119	2,4-Dimethylbenzylamine	218-9									223	Hydrochloride, 212, Chloroplatinate, 226

\*Derivative data given in order m p, crystal color, solvent from which crystallized



**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	$n_D$	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenylthiourea	Picrate	Miscellaneous
120	2-Amino-N,N-dimethylaniline	219				72	51				138 40	
121	3,5-Dimethylaniline ( <i>m</i> -5-Xylidine)	220	9 8	1 5581 <sup>20</sup>	0 9706 <sup>20</sup>	144, 140	144-5			153	200	N-Formyl deriv , 76
122	N-Ethyl-3-methylaniline (N-Ethyl- <i>m</i> -toluidine)	221, 215					72					Hydrochloride, 159, Chloroplatinate, 182
123	3,5-Dimethylbenzylamine	221		1 5305 <sup>20</sup>	0 950 <sup>20</sup>						225	Hydrochloride, 245, Chloroplatinate, 204
124	2,3-Dimethylaniline ( <i>o</i> -3-Xylidine)	221-2	3 5	1 5684 <sup>20</sup>	0 9931 <sup>20</sup>	135	189				221	Hydrochloride, 254, N-Formyl deriv , 102
125	1-Aminoindane (1-Hydrindamine)	222					142 3				207	
126	3-Phenylpropylamine	222			0 976 <sup>25</sup>		57 8				152 3	Hydrochloride, 218
127	2-Methyl-4,5,6,7-tetrahydroindole	222			0 987 <sup>10</sup>			86-91			141	Methiodide 195, Chloroplatinate, 187
128	N- <i>n</i> -Propylaniline	222			0 949 <sup>18</sup>	47		54		104	151	Hydrochloride, 173
129	2- <i>n</i> -Propylaniline	222-4				104-5	119					
130	2-Chloro-4-methylaniline	223				113	137					
131	$\alpha$ -Amino- <i>n</i> -butylbenzene	223			0 9367 <sup>20</sup>		128					Chloroplatinate, 184, Hydrochloride, 288
132	<i>trans</i> -9-Aminodecalin	223	-25	1 492 <sup>20</sup> <sub>He</sub>	0 939 <sup>20</sup>	183	148 9					N-Formyl deriv , 172
133	$\gamma$ -Amino- <i>n</i> -butylbenzene	223		1 5152 <sup>20</sup>	0 9289 <sup>15</sup>		108, lgr					Hydrochloride, 144, Chloroplatinate, 220
134	2-Methoxyaniline ( <i>o</i> -Anisidine)	225	5-6			85, 88	60, 84	89	127	136	200	N-Formyl deriv , 84
135	4-Isopropylaniline ( <i>p</i> -Cumidine)	225			0 953 <sup>20</sup>	102	162					
136	4- <i>n</i> -Propylaniline	225				93-4	115					Hydrochloride, 203 4
137	N-Isobutylaniline	227			0 940 <sup>18</sup>				122 3			
138	$\alpha$ -Methyl- $\alpha$ -phenylhydrazine	227		1 5824 <sup>20</sup>		92	153	132				
139	4- <i>tert</i> -Butylaniline	228	17			173	140		179-80			N-Formyl deriv , 59 Hydrochloride, 270-4
140	<i>cis</i> -9-Aminodecalin	228	-13 5	1 498 <sup>21</sup> <sub>He</sub>	0 951 <sup>21</sup>	127	147					N-Formyl deriv , 165-6
141	2-Ethoxyaniline ( <i>o</i> -Phenetidine)	229				79	104	102	164	137		
142	2,4,6-Trimethylaniline (Mesidine)	229, 232				216	204	137	167	193	189-91	
143	2-Aminoindane (2-Hydrindamine)	230				127	155				239	Hydrochloride, 241
144	3-Chloroaniline	230, 236		1 5931 <sup>20</sup>	1 2225 <sup>15</sup>	72, 78	119-20	121	138, 210	124, 116	177	
145	2,2'-Diaminodiethylsulfide	231 3									212	Dihydrochloride, 131
146	1,2,3,4-Tetrahydroisoquinoline	233		1 5798 <sup>23</sup>	1 064 <sup>23</sup>	46	129	154			200, 195	
147	2- <i>tert</i> -Butylaniline	233-5		1 5453 <sup>20</sup>	0 977 <sup>15</sup>	159-61						
148	3-Amino-4-(dimethylamino)toluene	234									151	Hydrochloride, 192 3
149	4-Isobutylaniline	235, pale				127			136-7			
150	4-Aminoindane (4-Hydrindamine)	236	-3			126	136					
151	2-Aminoundecane (2-Aminohendecane, <i>sec</i> - <i>n</i> -Undecylamine)	237				58					111	Hydrochloride, 84
152	<i>unsym</i> -Ethylphenylhydrazine	237			1 018 <sup>15</sup>							Hydrochloride, 137, Reduces warm Fehling

\* Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	$n_D$	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenylthiourea	Picrate	Miscellaneous
153	<i>sym</i> -Ethylphenylhydrazine	238.9		1.55 <sup>15</sup>	1.004 <sup>15</sup>		100					Hydrochloride, 164, Oxalate, 167
154	2-Bromo-4-methylaniline (3-Bromo- <i>p</i> -toluidine)	240	26		1.51 <sup>20</sup>	118	149					Hydrochloride, 221
155	1-Aminoundecane (1-Aminohendecane, <i>n</i> -Undecylamine, <i>n</i> -Hendecylamine)	240	15-6			48	60					Hydrochloride, 190
156	4-Chloro- <i>N</i> -methylaniline	240			1.169 <sup>11.5</sup>	92-4					153	Nitrosamine, 51
157	4-Chloro-2-methylaniline (5-Chloro- <i>o</i> -toluidine)	241	29			140						
158	2-Amino- <i>p</i> -cymene ( <i>p</i> -Cymidine)	241		1.543 <sup>19</sup>	0.994 <sup>20</sup>	71	102					Hydrochloride, 207
159	<i>N</i> -Butylaniline	241		1.5381 <sup>20</sup>	0.9358 <sup>20</sup>		56		56			
160	Phenylhydrazine	243	19-23	1.6081 <sup>20</sup>	1.0978 <sup>20</sup>	128	168, 177 ( <i>di</i> )	148	151	172		
✓ 161	$\alpha, \alpha'$ -Diamino- <i>m</i> -xylene ( <i>m</i> -Xylylenediamine)	245.8				<i>di</i> , 134, 5, <i>bz</i>	<i>N, N'</i> - <i>di</i> , 172, 135				185-90	Dihydrobromide, 266
162	2-Chloro-6-methoxyaniline (3-Chloro- <i>o</i> -anisidine)	246 sl d										
163	3-Ethoxyaniline ( <i>m</i> -Phenetidine)	248				97	103		157	138	158	
164	4-Ethoxyaniline ( <i>p</i> -Phenetidine)	248, 254	2-3		1.0651 <sup>16</sup>	137	173	143	106	136	69	
165	1,2,3,4-Tetrahydroquinoline	250	20	1.593 <sup>24</sup>	1.054 <sup>24</sup>		75	67				
166	2-Aminoacetophenone	250.2d	20			76.7	98		148			Semicarbazone, 290, Oxime, 109, Hydrochloride, 168 d
167	3-Bromoaniline	251	18	1.626 <sup>20</sup>	1.579 <sup>20</sup>	87	120, 136			143	180	
168	3-Methoxyaniline ( <i>m</i> -Anisidine)	251				81			68		169	Hydrochloride, 167.8
169	3-Bromo-2-methylaniline (6-Bromo- <i>o</i> -toluidine)	254				163	176-7					
✓ 170	4-Amino-1,2,3,5-tetramethylbenzene (Isoduridine)	255	23-4			215-7					200	
✓ 171	Dicyclohexylamine	255 sl d	abt 20	1.488 <sup>18</sup>	0.925 <sup>18</sup>	103	153				173	
172	6-Methyl-1,2,3,4-tetrahydroisoquinoline	256			1.0235 <sup>4</sup>						205	Hydrochloride, 195-7, Methiodide, 144.5, <i>N</i> -Nitroso deriv., 98
✓ 173	4-Amino- <i>N, N</i> -diethylaniline	261				104	172					
✓ 174	4- <i>n</i> -Butylaniline	261			0.945 <sup>20</sup>	105	126					Chloroplatinate, 200-2
175	1-Amino-5,6,7,8-tetrahydronaphthalene	261.3		1.5896 <sup>23</sup>	1.0625 <sup>16</sup>	158						Hydrochloride, 259.61
176	7-Methyl-1,2,3,4-tetrahydroquinoline	264					70-2				153-4	Hydrochloride, 175
177	4-Methylindole	267	5		1.062 <sup>20</sup>						194.5	
178	2-Amino-4-chloro- <i>N, N</i> -dimethylaniline	267.8				90					191	
179	DL-3-Aminopropylene-glycol (2,3-Dihydroxypropylamine)	268 part d		1.49 <sup>10</sup>	1.175 <sup>20</sup>		<i>O, N</i> - <i>di</i> , 109 <i>O, O, N</i> - <i>tri</i> , 113					Chloroplatinate, 185, Picrolonate, 220, <i>O, N</i> - <i>di</i> -4-Nitrobenzoyl deriv., 139

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub>	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	p-Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
180	Diethanolamine (Di-(2-hydroxyethyl)-amine)	270	28	1.4776 <sup>40</sup>	1.0966 <sup>20</sup>						110	Nitrate, 69, Chloroplatinate, 160
181	3-(Dimethylamino) aniline	272			0.995 <sup>25</sup>	87.69 (di)	163.4				187	N-Chloroacetyl deriv., 102
182	1-(N,N-Diethylamino) naphthalene	290		1.5961 <sup>40</sup>	1.015 <sup>20</sup>						152.4	1,3,5-Trinitrobenzene add comp., 95, scar
183	1-(Methylamino) naphthalene	294				94.5	121		164			
184	Dibenzylamine	300		1.5743 <sup>22</sup>	1.0256 <sup>22</sup>		112	68	159			Hydrochloride, 256
185	α-Aminodiphenylmethane (Benzhydrylamine)	303-4		1.5963 <sup>21, 5</sup>	1.0635 <sup>21, 5</sup>	146.7	172.167				205.6	N-Formyl deriv., 132
186	1,2-Diphenylethylamine	313			1.031 <sup>15</sup>						212.3	Oxalate, 158, Chloroplatinate, 188
187	2,3-Diphenylpropylamine	315.7				85 (di)						Hydrochloride, 188 90, Chloroaurate, 144.5
188	2-(Methylamino) naphthalene	317, 309				51	84	107	78		145	Hydrochloride, 182.3
189	2-(N,N-Diethylamino) naphthalene	320.2										1,3,5-Trinitrobenzene add comp., 116, blk., Hydrochloride, 177, Chloroplatinate, 95

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines a) Liquids 2) (b.p. at reduced pressure only)**  
**(Listed in order of increasing m.p. of the corresponding acetyl derivative)\***

No	Name	Boiling point, °C	Melting point, °C	$n_D$	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
1	3-Aminostyrene	112 5 <sup>12</sup>			1 0216 <sup>20</sup>	74 5	90, bz - lgr, 126, al -w					Polymerizes readily
2	2-Bromo-4-ethoxyaniline (3-Bromo- <i>p</i> -phenetidine)	160 <sup>23</sup>				97						
3	3-Aminothiophenol	180-90 <sup>16</sup>				N,S- <i>di</i> 97						Hydrochloride, 232
4	2- <i>n</i> -Butylaniline	122 5 <sup>12</sup>			0 953 <sup>20</sup>	100	116 7					Hydrochloride, 137
5	2-(2-Aminophenyl)ethyl alcohol	147 8 <sup>3,5</sup>		1 5849 <sup>19</sup>		103 5						Hydrochloride, 126
6	6-Amino-3,4'-dimethylbiphenyl	165 7 <sup>4</sup>				104						Hydrochloride, 216-26
7	2,2-Diphenylpropylamine	179-82 <sup>22</sup>			1 027 <sup>18</sup>	106 7	82-3					Hydrochloride, 261
8	2-Chloro-4-methoxyaniline (3-Chloro- <i>p</i> -anisidine)	156 <sup>31</sup>				114						Hydrochloride, 228
9	2-Aminostyrene	97 8 <sup>5</sup>		1 6130 <sup>21</sup>	1 015 <sup>21</sup>	129						Polymerizes readily
10	2-Aminothiophene	77 9 <sup>11</sup>				161 2	172-3					Oxidizes rapidly, N-2-toluenesulfonyl deriv, 183 4
11	4,4'-Diamino-2,3'-dimethylbiphenyl	244 <sup>12</sup>				N N'- <i>di</i> 253, <i>tetra</i> 191	N,N'- <i>di</i> 245					

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenylthiourea	Picrate	Miscellaneous
1	Di- <i>n</i> -heptylamine	1	271						117-20	
2	4-Aminostyrene	23.5	98 <sup>a</sup>	142	160-1					D <sub>4</sub> <sup>1</sup> 1 012 n <sub>D</sub> <sup>20</sup> 1.625
3	3-Bromo-4-methylaniline (2-Bromo- <i>p</i> -toluidine)	25-6	254-7	117-8	132					
4	2-Amino-3-methylpyridine (2-Amino- $\beta$ -picoline)	26	224	64	220				229	
5	2-Aminothiophenol	26	234	135 ( <i>N,S-di</i> )	154 ( <i>N,S-di</i> )					
6	<i>n</i> -Dodecylamine	27-8	247-9				73			Hydrochloride, 98, Chloroplatinate, 215 Hydrochloride, 180 3
7	DL-2,6-Dimethyl-1,2,3,4-tetrahydroquinoline	31-2	267		103-5					
8	5-Bromo-2-methylaniline (4-Bromo- <i>o</i> -toluidine)	32	253 part d	165						
9	1-Amino-2-methylnaphthalene (2-Methyl-1-naphthylamine)	32		188	180					
10	2-Bromoaniline	32	250	99	116			146 161	129	
11	4,4'-Dimethyldibenzylamine ( <i>p</i> -Dixylamine)	32.5	220 <sup>30</sup>						153	Nitrosamine, 52, Hydrochloride, 272
12	2-Aminodibenzyl	33	173-83 <sup>11</sup>	117	166				167-8	Hydrochloride, 198
13	3-Iodoaniline	33.27	145.6 <sup>15</sup>	119	157		128			
14	unsym-Diphenylhydrazine	34	220 <sup>40-50</sup>	184	192					
15	$\alpha,\alpha$ -Diamino-1,4-dimethylbenzene ( <i>p</i> -Xylylenediamine)	35		194 ( <i>tetra</i> )	193 ( <i>N,N'-di</i> )				232	
16	3-Bromo-5-methylaniline (5-Bromo- <i>m</i> -toluidine)	36	255.60	171.2						
17	4-Amino- <i>N</i> -methylaniline	36	258	63	165				206	
18	Pentadecylamine	36, 33	300	72						Hydrochloride, 199
19	<i>N</i> -Benzylaniline	37	298	58	107	119	148-9	103	48	
20	3-Iodo-4-methylaniline (2-Iodo- <i>p</i> -toluidine)	37-8		130						Oxalate, 103
21	5-Aminoindane (5-Hydrindamine)	37-8	247-9 <sup>745</sup>	106	137					
22	2-Amino-5,6,7,8-tetrahydronaphthalene (5,6,7,8-Tetrahydro-2-naphthylamine)	38	275-7 <sup>112</sup>	107	167				204	
23	2-Amino-5-bromonaphthalene (5-Bromo-2-naphthylamine)	38	207.10 <sup>10</sup>	165	109				216	<i>N</i> -Benzal, 63
24	2,2-Diphenylethylamine	38	180 <sup>32</sup>	88	144.5				212.3	Phenylurethane 191.2, Hydrochloride, 256-7
25	2,3-Dimethyl-1,2,3,4-tetrahydroquinoline	38-9			92				178	
26	2-Iodo-4-methylaniline (3-Iodo- <i>p</i> -toluidine)	40		133	161					Oxalate, 120, Hydrochloride, 188
27	2-Chloro-4,6-dimethylaniline (5-Chloro- <i>m</i> -4-xylidine)	40		205-6	148					2-Naphthylthiourea 154
28	2-Amino-6-methylpyridine (6-Amino- $\alpha$ -picoline)	41	208-9	90	90				202	Hydrochloride, 155, Chloroplatinate, 218
29	4-Amino- <i>N,N</i> -dimethylaniline	41, 53	262	132-3	228				188	
30	1,6-Diaminohexane (Hexamethylenediamine)	42	204-5	125-7 ( <i>di</i> )	155 ( <i>di</i> )	154 ( <i>di</i> )			220	
31	1,3-Diaminopropanol	42	235						230	Hydrochloride, 185, Chloroplatinate, 240
32	4-Amino-3-methylbiphenyl	43	190 <sup>15</sup>	165, 158	189					<i>N</i> -Benzal, 108
33	2,4'-Diaminobiphenyl	45	363	202 ( <i>di</i> )	278 ( <i>di</i> )					
34	4-Methylaniline ( <i>p</i> -Toluidine)	45	200	147	158	120	118	141	182	
35	4-Aminothiophenol	46	140-5 <sup>16</sup>	154 ( <i>N</i> -), 144 (132) ( <i>N,S-di</i> )	180 ( <i>N</i> -)					Oxidized readily $\rightarrow$ 4,4-diaminodiphenyl sulfide, 104.5

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
36	4-Aminobenzyl cyanide	46		97 ( <i>mono</i> ) 152-3 ( <i>di</i> )	176-7				185	N-Formyl, 135
37	2-Aminopropiophenone	47	93 <sup>o</sup> *	71	130					Oxime, 88-9, Semicarbazone, 190, N-Propionyl, 51
38	3-Bromo-4-ethoxyaniline (2-Bromo- <i>p</i> -phenetidine)	47	189 <sup>20</sup>	114					178 9	
39	4-Amino-2-thiocresol	47		95 (N-), 125 (N,S- <i>di</i> )						S-Me, 47
40	2-Iodo-5-methylaniline (4-Iodo- <i>m</i> -toluidine)	48, 38		151, 146						N-Formyl, 129
41	1-Amino-4-fluoronaphthalene (4 Fluoro-1 naphthylamine)	48	162 <sup>16</sup>		197					Hydrochloride, 280
42	4-Aminodibenzyl	48			170 1					Hydrochloride, 210, Chloroplatinate, 286-9
43	3,4-Dimethylaniline ( <i>o</i> -4-Xylidine, 4-Amino- <i>o</i> -xylylene)	49	224	99		118				N-Formyl, 52, Hydrochloride, 256
44	2-Ethoxy-6-nitroaniline	49, yel		64						N-Me, 59
45	Heptadecylamine	49	335-40	62	91					
46	2-Aminobiphenyl	49	299	121	102					N-Formyl, 75, N-Propionyl, 65
47	4-Amino-2-methyldiphenylamine	49 50	196 <sup>4</sup>	139 40						Hydrochloride, 185 7
48	2-Bromo-4,6-dimethylaniline (5-Bromo- <i>m</i> -4-xylidine)	49 50		196 7	186				122	
49	2,5-Dichloroaniline	50	251	132	120				86	Hydrochloride, 191 2
50	1-Aminooxindole	50		186-7	189					
51	1-Aminonaphthalene ( $\alpha$ -naphthylamine)	50		159	160	167	157, 147	165	163 181	
52	1-Amino-1,2,3-triazole	51			151				130	Hydrochloride, 114
53	2-Amino-1-methylnaphthalene (1-Methyl-2-naphthylamine)	51		188 9	222					
54	1-Amino-3-methylnaphthalene (3-Methyl-1 naphthylamine)	51-2		175 6	188 9					
55	1-Amino-4-methylnaphthalene (4-Methyl-1-naphthylamine)	51-2	176 <sup>14</sup>	166 7	238-9					Hydrochloride, 233-4
56	4-Chloro-2-methoxyaniline (5-Chloro- <i>o</i> -anisidine)	52, 46	260	150					200	N-Formyl, 177 8, Hydrochloride, 238
57	Indole	52	253	157 8	68	254				N-Nitroso, 171
58	2-Aminodiphenylmethane	52	190 <sup>22</sup>	135	116					Hydrochloride, 137
59	2,2'-Ditolylamine (Di- <i>o</i> -tolylamine)	52 3	318		114-5					
60	4-Aminobiphenyl	53	302	171, 120 ( <i>di</i> )	230		255 160			N-Formyl, 172
61	1,4-Bis-(methylamino)benzene ( <i>o</i> , <i>m</i> -Dimethyl- <i>p</i> -phenylenediamine)	53	150 <sup>17</sup>						186	N,N'-Dinitroso, 148
62	Diphenylamine	53-4		101	180	124	141	152	182	
63	DL- $\alpha$ -Aminobenzyl cyanide	55			159 60				160-1	
64	4-Methoxy-3-nitroaniline (2-Nitro- <i>p</i> -anisidine)	57, or		153						N-Chloroacetyl, 150, N,N-Di-Me, 46, red
65	5-Bromo-2-ethoxyaniline (4-Bromo- <i>o</i> -phenetidine)	57 53		133					135 7	
66	2-Amino-5-bromobiphenyl	57		130	162					
67	4-Methoxyaniline ( <i>p</i> -Anisidine)	58	240	130, 127	154, 157	95	114	157, 171		
68	1-Amino-7-methylnaphthalene (7-Methyl-1-naphthylamine)	58-9	162 <sup>10</sup>	182-3	204					
69	4-Bromo-2-methylaniline (5-Bromo- <i>o</i> -toluidine)	59	240	156-7	115					

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point C	Boiling point C	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
70	2-Amino-1 chloronaphthalene (1 Chloro 2 naphthylamine)	59		147	98	131				N Formyl 136
71	2-Aminoazobenzene	59		126	122					
72	1-Amino 2-chloronaphthalene (2 Chloro 1 naphthylamine)	59 60		191 ( <i>mono</i> ) 88 ( <i>di</i> )						
73	5-Methylindole	60	267						151	
74	2-Aminopyridine	60 58	204	71	165 ( <i>di</i> )				216 7	
75	3-(3 Indolyl)-propylamine	60 4							146 9	Hydrochloride 170
76	2-Methylindole	61	271 2						156 139	1 3 5 Trinitrobenzene add comp 152 N Formyl 75 Hydrochloride 153 4
77	2-Iodoaniline	61 58		109	139				112	
78	1 Naphthyl phenyl amine (N Phenyl 1 naphthylamine)	62	226 <sup>+</sup>	115	157					
79	3-Chloro-4 methoxyaniline (2 Chloro <i>p</i> anisidine)	62		94					186	
80	1-Amino-3 chloronaphthalene (3 Chloro 1 naphthylamine)	62		197	162					Hydrochloride 219
81	2-Amino-4,4 -dimethylbiphenyl	62 3		118 9	95 6					
82	8-Amino-6-methylquinoline	62 4		91 2						1 3 5 Trinitrobenzene add comp 139 N Propionyl 139 N Benzal 93 4 1 3 5 Trinitrobenzene add comp 192
83	2-Amino-1 bromonaphthalene (1 Bromo 2 naphthylamine)	63		<i>mono</i> 140 <i>di</i> 105						
84	1,3-Diaminobenzene ( <i>m</i> Phenylene diamine)	63	282 4	191 ( <i>di</i> ) 87 9 ( <i>mono</i> )	240 ( <i>di</i> ) 125 ( <i>mono</i> )	194	172		184	
85	2,4-Dichloroaniline	63	245	145	117	128	126		106	
86	2-Amino 5 methyl naphthalene (5 Methyl 2 naphthylamine)	63 4		123 4	155 6					
87	3-Bromo-4-methoxyaniline (2 Bromo <i>p</i> anisidine)	64		111						Hydrochloride 255
88	2,5-Diaminotoluene	64	273 4	220 ( <i>di</i> )	307	2 <i>mono</i> 147	2 <i>mono</i> 150			
89	3-Aminopyridine	64	250 2	<i>mono</i> 133 <i>di</i> 88	119					
90	9-Amino fluorene	64		262	260 1					Hydrochloride 255
91	4-Methylphenylhydrazine ( <i>p</i> Tolyhydrazine)	65	240 4d	121	1 N <i>mono</i> 68 70 2 N <i>mono</i> 146					
92	4-Aminobenzyl alcohol	65		188 (O N <i>di</i> )	4 <i>mono</i> 150					Hydrochloride 217
93	2-Bromo-6-methoxyaniline (3 Bromo <i>o</i> anisidine)	65			90					Hydrochloride 225
94	1,3-Diamino-2,6-dimethylbenzene (2 4 Diamino <i>m</i> xylene)	65 6		> 260 ( <i>di</i> )	232 (227) ( <i>di</i> )					N N Di formyl 220
95	Aminoacetamide (Glycineamide)	65 7								Hydrochloride 186 9 Chloroaurate 197 8 Hot H <sub>2</sub> O → glycine + NH <sub>3</sub> Hydrochloride 175 N Phenyl 150
96	2-Aminocyclohexanol	66	219							
97	2-Amino-5-methylbenzophenone	66 yel		159	118				145	
98	4-Bromoaniline	66	245	168	204	134		148	180	
99	1,8-Diaminonaphthalene	66		311 2 ( <i>di</i> )			207 ( <i>di</i> )			

\*Derivative data given in order m p crystal color solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES  
1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
100	3-Amino-5-bromopyridine	66-7	150 <sup>12</sup>	76-8 (hyd) 127 (anh)					212-3	Chloroaurate, 185 7
101	1-Amino-8-methylnaphthalene (8-Methyl-1-naphthylamine)	67 8		183-4	195-6					
102	4-Iodoaniline	67-8		184	222			153		N 4-Nitrobenzoyl, 269 N-Benzal, 86
103	1-Amino-2,4,5-trimethylbenzene (Pseudocumidin)	68		162	167	136				
104	2,2'-Diaminodibenzyl	68		249 (di)	255 (di)				225 30	
105	2-Amino-4-methylnaphthalene (4-Methyl-2-naphthylamine)	68		172 3	194-5					
106	3-Nitro-N-methylaniline	68		95	105	83				
107	1-Amino-3-bromonaphthalene (3-Bromo-1-naphthylamine)	70		174	166					Hydrochloride, 247
108	1-Amino-5-methyl-1,2,3-triazole	70			158, 138 (di)					N-Benzal, 67 8, Hydrochloride, 138
109	8-Aminoquinoline	70, 65, yel		103	98		154-6			Hydrochloride, 208 9
110	2-Nitroaniline	71, golden-yel		92, 94	98, 110	104	142		73	
111	3,4-Diaminotriphenylmethane	71 2		226 (di)	243 (di)					
112	4-Chloroaniline	72		179, 172	192	122	95, 119	152		
113	8-Amino-6-Chloroquinoline	73								Hydrochloride 208 Chloroplatinate, 212, Methiodide, 178
114	4-Aminophenylurethane (N-carbethoxy-1,4-diaminobenzene)	73-4		202, 181	230					Hydrochloride, 242
115	4-Aminodiphenylamine	75 (anh)		158	203					
116	3,5-Dimethylindole	75	278						180	
117	Duridine (3-Amino-1,2,4,5-tetramethylbenzene)	75	261	207						Hydrochloride, 260
118	1-Amino-3,4,5-trimethylbenzene	75	240	163 4						N-Formyl, 98
119	2-Amino-1,4-dimethylnaphthalene (1,4-Dimethyl-2-naphthylamine)	75	333	219-20						
120	4-Nitrosesidine (2-Amino-4-nitrosesitylene)	75		191	169	163				
121	2-Methoxy-6-nitroaniline (3-Nitro- <i>o</i> -anisidine)	76, yel		158-9						N-Me, 58, red
122	2-Bromo-1,4-diaminobenzene (2-Bromo- <i>p</i> -phenylenediamine)	76		200(di)	235(di)					
123	4,6-Dimethyl-2-nitroaniline (5-Nitro- <i>m</i> -4-xylidine)	76, 70		176, 173	185					
124	1-Amino-5-methylnaphthalene (5-Methyl-1-naphthylamine)	77-8		194-5	173-4				210 d	
125	2,4,6-Trichloroaniline	78	263	204, 206	174	152-4			83	
126	4-Methyl-3-nitroaniline (2-Nitro- <i>p</i> -toluidine)	78		148	172	160	164	171		
127	2,4-Dibromoaniline	79		146	134		134		124	
128	1-Naphthyl 4-tolyl amine	79		124	140					
129	2-Aminodiphenylamine	79-80		121 (2-N-)	136 (2-N-)					
130	2,4-Diaminophenol (4-Hydroxy- <i>m</i> -phenylenediamine)	79-80		220-2 (2,4-N-) 180-2 (tri)	253 (di)				120	
131	4-Aminopyrazole	80-2			173 (di)				193-4	

\*Derivative data given in order m p, crystal color, solvent from which crystallized



**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenylthiourea	Picrate	Miscellaneous
132	4-Bromo-3-methylaniline (6-Bromo- <i>m</i> -toluidine)	81	240	103-4						N,N-Di-Me, 55
133	2,2'-Diaminodibenzyl sulfide	81		209 ( <i>di</i> )					203 4	N,N'-Di-formyl, 163
134	2,2'-Diaminobiphenyl	81	162*	<i>mono</i> 89, <i>di</i> 161	159 (2-N-) 190 ( <i>di</i> )					N,N'-Di-formyl, 137
135	3-Aminoaceneaphthene	81		192 3, al	209, al				221	N-Formyl, 151, Alc, FeCl <sub>3</sub> → bl-vlt col
136	2-Aminobenzyl alcohol	82	270 80 part d	N- <i>mono</i> 114	O- 198-9				110	Hydrochloride, 108
137	1-Amino-1,3,4-triazole	82 3							194-5	Hydrochloride, 153, N-Formyl, 117, Chloro- platinate, 230
138	4-Chloro-3-methylaniline (6 Chloro- <i>m</i> -toluidine)	83		91	119					2-Naphthylthiourea, 158
139	2,6-Dibromoaniline	83-4	262-4	210					123-4	
140	5-Chloro-2-methoxyaniline (4-Chloro- <i>o</i> -anisidine)	84		104	77 8				194	
141	4-Aminotriphenylmethane	84, bz	248 <sup>12</sup>	168	198					N,N-Di-Me, 132
142	1-Amino-3-iodonaphthalene (3-Iodo-1-naphthylamine)	84		207	174					
143	4-Aminobutyrophenone	84		142						Hydrochloride, 178
144	4,4'-Diaminodiphenyl disulfide	85, yel, 106		205 ( <i>di</i> )						N,N'-Dicarboxy, 136-7
145	7-Methylindole	85	266		84				176	
146	2-Amino-4-bromobenzaldehyde	85								Oxime, 194, Phenylhydra- zone, 215
147	2,2'-Diaminodiphenyl sulfide	85 6		160 ( <i>di</i> )	162 3 ( <i>di</i> )					
148	4-Aminoveratrol (3,4-Dimethoxy- aniline)	85 6	174 6	133	177					Chloroplatinate, 227
149	2-Aminophenanthrene	85, pa yel		225	216					
150	4-Aminobenzonitrile	86		205	170				150	N-Formyl, 188-9, N-Propionyl, 169
151	4-Iodo-2-methylaniline (5-Iodo- <i>o</i> - toluidine)	87 92		170, 162	184				189	N-Benzal, 55, Phenyl- urethane, 232
152	4-Aminoaceneaphthene	87		175 6	196				190- 200	
153	3-Aminoacetanilide	87 9		191			241			
154	3-Aminophenanthrene	87 5		200-1	213					
155	4-Amino-3-methyl-1-phenylpyrazole	88	312	94 5 (hyd), 120(anh)	181				138	N-Formyl, 112 (anh), 81 (hyd), Chloroplatinate, 226
156	2-Hydroxy-3-methylaniline (3-Amino- <i>o</i> -cresol)	89		N- <i>mono</i> 78-9						N-Acetyl of Me eth, 100
157	3,4-Diaminotoluene	89 90	265	210 ( <i>di</i> ), 95 (3-N), 131 (4-N)	263-4 ( <i>di</i> )	178-9 ( <i>di</i> )	4- <i>mono</i> 140			
158	2-Nitrophenylhydrazine	90, red		140 1, <i>di</i> 57 8	166					N-Formyl, 177
159	2,2'-Diaminodibenzyl disulfide	90-1		202-5 ( <i>di</i> )						
160	4-Chloro-1,3-diaminobenzene	91		242 ( <i>di</i> )	178 ( <i>di</i> )		215			N,N'-Dipropionyl, 190-1
161	1-Amino-2,6-dimethylnaphthalene (2,6-Dimethyl-1-naphthylamine)	91		211	219-20					
162	1-Amino-4-mercaptanaphthalene (4-Amino-1-thionaphthol)	91 3		N- <i>mono</i> 173						S-Me, 54
163	2-Methyl-3-nitroaniline (6-Nitro- <i>o</i> -toluidine)	92 97		158	168					
164	2-Methyl-6-nitroaniline (3-Nitro- <i>o</i> -toluidine)	92	305d	158	167					1-Naphthylthiourea, 171

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES  
1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	p-Toluene sulfonamide	Phenylthiourea	Picrate	Miscellaneous
165	3-Bromo-2-hydroxy-5-methylaniline (3-Amino-5-bromo-p-cresol)	93		N-mono 129 dt 169	N-mono 185 dt 166	N-mono 157 dt 230				
166	4-Chloro-2,6-dibromoaniline	93		226	194					
167	2,2'-Diaminodiphenyl disulfide	93		156 (dt)					141 (dt)	
168	1,18-Diaminooctadecane	93			150 (dt)					Hydrochloride >225
169	4,4'-Diaminodiphenylmethane	93	232 <sup>a</sup>	236 (dt) (228)						N,N-Dibenzal, 130
170	3-Nitrophenylhydrazine	93, yel		145 150 (dt)	151 153 (dt)					
171	7-Aminoquinoline	93 4 (anh), 73 (hyd)		167	189					Chloroplatinate, 225
172	2-Aminodibenzfuran	94		178 83 (dt)	201					
173	3-Aminoquinoline	94 84		172 167					210	
174	7-Amino-2,4-dimethylquinoline	94 100	> 300	212					215 7	
175	Skatole (3 Methylindole)	95	267	68					170 1	Hydrochloride, 167 8, N-Propionyl, 45
176	2-Chloro-4,6-dibromoaniline	95		227	192					
177	4-Hydroxybenzylamine	95								Hydrochloride, 195, N-Acetyl of Me ether, 96
178	1-Amino-4,5-dimethyl-1,2,3-triazole	95							124 5	Hydrochloride 131, Chloroplatinate, 215
179	1-Amino-8-hydroxynaphthalene (8 Hydroxy-1-naphthylamine 8 Amino-1-naphthol)	95-7		N-mono 181 N O dt 118	N-mono 193, N,O-dt 206		N mono 189		163 4	N-Formyl, 140 50
180	5-Amino-2-methylpyridine (5 Amino-α-picoline)	96		126	111				201	Dihydrochloride, 215 8
181	4,4'-Diamino-3,3'-dimethyl-diphenyl sulfide	96		dt 220	dt 233				186 (dt)	Dihydrochloride, 248-9
182	6,6'-Diamino-3,3'-dimethyl-diphenylmethane	96		226 (dt) 152 (tetra)					199	Dihydrochloride, 248 9
183	N-Ethyl-4-nitroaniline	96		119	98		107			
184	2,4-Di-iodoaniline	96		141 171	181					
185	1-Amino-8-nitronaphthalene (8-Nitro-1-naphthylamine)	97, red		191		194				
186	3-Aminobenzyl alcohol	97		N mono 106-7	N-mono 115 N,O-dt 113 4					
187	5-Bromo-2-methoxyaniline (4-Bromo-o-anisidine)	97-8		160	108					
188	2-Amino-4-methylpyridine (2-Amino-γ-picoline)	98		102-3	114, 182 3 (dt)				227	
189	2-Aminophenacyl alcohol	98		N-mono 141	N,O-dt 167					Phenylhydrazone, 198
190	1-Amino-4-chloronaphthalene (4-Chloro-1-naphthylamine)	98		186						
191	1,2-Diaminonaphthalene	98		234 (dt)	291 (dt)	1-mono 215				
192	4-Amino-4'-methylbiphenyl	99	190 <sup>18</sup>	221						Hydrochloride, 280 3
193	3-Aminoacetophenone	99		128-9			130			Semicarbazone, 196
194	2,4-Diaminotoluene	99		N,N'-dt 224	224 (dt)	2-mono 138, 2,4-dt 192	4-mono 160, 2,4-dt 192-3			

\*Derivative data given in order, m p, crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES  
 1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
195	4-Amino-3,2'-dimethylazobenzene	100, yel		185 ( <i>mono</i> ), 65 (75) ( <i>di</i> ), 1gr						N-Chloroacetyl, 171-2
196	1,2-Diaminobenzene ( <i>o</i> -Phenylene-diamine)	102	256-8	185 ( <i>di</i> )	301 ( <i>di</i> )	185	260 ( <i>di</i> )		208	
197	1-Amino-4-bromonaphthalene (4-Bromo-1-naphthylamine)	102, 95		193						N-Formyl, 172, 1,3,5-Trinitrobenzene add comp, 196
198	2-Naphthyl 4-tolyl amine	103		85	139					
199	3,4-Diaminobiphenyl	103		3- <i>mono</i> 211 4- <i>mono</i> 155, 3,4- <i>di</i> 163 165 ( <i>di</i> )	3- <i>mono</i> 186, 4- <i>mono</i> 221, 3,4- <i>di</i> 248 185 ( <i>di</i> )					
200	6,6'-Diamino-3,3'-dimethyldiphenyl sulfide	103-4							179 ( <i>di</i> )	
201	2-Amino-8-nitronaphthalene (8-Nitro-2-naphthylamine)	104, red		196	162					
202	Piperazine	104	140	<i>mono</i> 52, <i>di</i> 144	<i>mono</i> 75, <i>di</i> 196	282 ( <i>di</i> )	173		280	
203	4,4'-Diaminodibenzyl sulfide	104-5		188 ( <i>di</i> )	224 ( <i>di</i> )					
204	3-Amino-4,4'-dimethylbiphenyl	104-5		156-7	160 1					Hydrochloride, abt 230
205	1,3-Diamino-4,6-dimethylbenzene (4,6-Diamino- <i>m</i> -xylene)	105		1- <i>mono</i> 165, <i>di</i> 295	258 9 ( <i>di</i> )		221 ( <i>di</i> )			N,N-Diformyl 182 3
206	2-Bromo-4-nitroaniline	105, yel		129	160					N-Me, 118
207	Triphenylmethylamine	105		207-8	160-2					N-Benzyl, 110
208	4-Aminophenanthrene	105		190	224				216	
209	2-Aminobenzophenone	105-6, pa yel		72, 89	80					Oxime (alkali-stable), 156, (acid stable), 127; N Propionyl, 78
210	3-Amino-6-phenylpyridine	105-6		148-9	201					
211	3-Amino-4-methylpyridine (3-Amino- $\gamma$ -picoline)	106	260	84	81				179 80	Chloroplatinate, 227, Hydrochloride, 180
212	4-Bromophenylhydrazine	106								Acetophenone deriv, 112
213	4-Aminoacetophenone	106	294	167	205	128	203			Semicarbazone, 250, Oxime, 148
214	2,4-Diaminopyridine	107			191-2 ( <i>di</i> )					Chloroplatinate, 224
215	9-Phenanthrylmethylamine	107		182-5	167				241	N-Benzal, 104
216	2-Methyl-5-nitroaniline (4-Nitro- <i>o</i> -toluidine)	107		151		172				N-Formyl, 178 9, N-4-Nitrobenzoyl, 214
217	2,5-Diaminopyridine	107-10		290 ( <i>di</i> )	230 ( <i>di</i> )					
218	2-Naphthyl phenyl amine	108		93	148, 136					
219	2-(4-Aminophenyl) ethyl alcohol	108		105	O- <i>mono</i> 59-60, N,O- <i>di</i> 136	93				Hydrochloride, 171
220	5-Aminoacenaphthene	108		238 ( <i>mono</i> ), 122 ( <i>di</i> )	210, 199				190 200	N-Formyl, 172, FeCl <sub>3</sub> → bl col
221	4,4'-Diamino-2,2'-dimethylbiphenyl ( <i>m</i> -Tolidine)	108 9		281 (275) ( <i>di</i> )					225	N,N'-Dibenzal, 172-3
222	4-Aminoantipyrine (4-Amino-2,3-dimethyl-1-phenylpyrazolone-5)	109, yel		199					144	
223	3-Amino-4-methylbenzophenone	109		108						Hydrobromide, 130, dil HBr
224	2-Aminobenzamide	109-11		177	214-5					
225	1,4-Diamino-2-iodobenzene (2-Iodo- <i>p</i> -phenylenediamine)	110 5		211	254					

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
226	<b>5-Aminoquinoline</b>	110	310	178			203 4			
227	<b>4-Amino-2-nitrostilbene</b>	110 1, dk red		192 3						Hydrochloride, 223
228	<b>3-Aminocamphor</b>	110 5		121	141				191	Oxime, 145, N-Formyl, 87
229	<b>4-Bromo-2-nitroaniline</b>	111, or		104	137-8					N-Me, 102, N-Et, 91
230	<b>3'-Amino-4-methylbenzophenone</b>	111		139						Oxime, 146, Hydrochloride, 198
231	<b>4-Amino-3-methylbenzophenone</b>	112, pale yel		175	158					N-Propionyl, 128
232	<b>2-Aminonaphthalene (<math>\beta</math>-Naphthylamine)</b>	112		132	162	102	133	129	195	
233	<b><math>\beta</math>-Aminopropiophenone (1-Aminoethyl phenyl ketone)</b>	112 4 (unst)		90-1	104-5				164 5	Hydrochloride, 187, Chloroplatinate, 205
234	<b>2-Hydroxybenzylaniline</b>	113		93						Hydrochloride, 131, Chloroplatinate, 184
235	<b>4-Ethoxy-2-nitroaniline (3-Nitro <i>p</i>-phenetidine)</b>	113, 108, red		104		72	94			
236	<b>5-Bromo-2-hydroxy-3-methylaniline</b>	113		<i>N</i> -mono 119 <i>di</i> 200	<i>N</i> -mono 195					
237	<b>3-Nitroaniline</b>	114		<i>mono</i> 155, <i>di</i> 76	155, 150 ( <i>di</i> )	136	138	160	143	
238	<b>6-Aminoquinoline</b>	114 (anh)		<i>mono</i> 138, <i>di</i> 75	169		193			Methodide, 199
239	<i>cis</i> -2,5-Dimethylpiperazine	114	162		152 ( <i>di</i> )		146-7 ( <i>di</i> )			N,N'-Dinitroso, 95
240	<b>3-Amino-2-phenylquinoline</b>	115 6	223 <sup>3</sup>	<i>mono</i> 124, <i>di</i> 173	179 80				194 5	Methodide, 238, Ethiodide, 202
241	<b>5-Amino-3-methyl-1-phenylpyrazole</b>	116	333	110					160 2	Hydrochloride, 199 200
242	<b>4-Aminotriphenylcarbinol</b>	116		176						N,N-Dimethyl, 92-3
243	<b>5-Bromo-2-hydroxy-4-methylaniline</b>	116		<i>N</i> -mono 199, <i>di</i> 188	<i>N</i> -mono 223					
244	<b>4-Chloro-2-nitroaniline</b>	116-7, yel		104			110			
245	<b>4-Methyl-2-nitroaniline (3-Nitro-<i>p</i>-toluidine)</b>	117		99	148	102	146			Hydrochloride, 170 1
246	<b>5-Amino-2-methylquinoline (5-Aminoquinaldine)</b>	117 8 (anh), grnsh		205						N-Cinnamoyl, 257
247	<i>trans</i> -2,5-Dimethylpiperazine	118	162		228 9 ( <i>di</i> )		225 ( <i>di</i> )			N,N'-Dinitroso, 174
248	<b>2,3,4,6-Tetrabromoaniline</b>	118		228-9						1,3,5-Trinitrobenzene add comp, 108
249	<b>2-Methoxy-5-nitroaniline (4-Nitro-<i>o</i>-anisidine)</b>	118, or -red		175 6	160-1		128			N-Me, 87
250	<b>4-Hydroxypyrazole</b>	118			109 ( <i>di</i> )				129	
251	<b>2-Amino-5,4'-dimethylazobenzene</b>	118-9, or -red		157	135					N-Carboxy, 94
252	<b>1-Amino-5-nitronaphthalene (5-Nitro-1-naphthylamine)</b>	119, red		220		183				N-Formyl, 199
253	<b>5-Hydroxy-2,4,6-tribromoaniline</b>	119		O,N,N- <i>tri</i> 136			146 7			
254	<b>1,4-Diaminonaphthalene</b>	120		303 ( <i>di</i> )	<i>mono</i> 186, <i>di</i> 280		<i>mono</i> 187 8			
255	<b>1,9-Diaminofluorene</b>	120		293 ( <i>di</i> )	abt 310 ( <i>di</i> )				205	
256	<b>2-(<math>\omega</math>-Aminoethyl)-indole (2-(2-Indolyl)-ethylamine)</b>	120			173 4					N-Benzal, 122
257	<b>2,2'-Diamino-4,4'-dimethylbiphenyl</b>	120		189 ( <i>di</i> )	170 ( <i>di</i> )					N,N'-Di-formyl, 185

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
258	<b>2,6-Diaminopyridine</b>	121		203 ( <i>dt</i> )	176 ( <i>dt</i> )				240	
259	<b><i>cis</i>-4,4'-Diaminostilbene</b>	121, pale yel		172 ( <i>dt</i> )	253 ( <i>dt</i> )					
260	<b>4-Aminobenzhydrol</b>	121			145					Hydrochloride, 270 3
261	<b>3-Amino-6-hydroxyacetophenone</b>	121 110 yel		<i>N</i> -mono 165 <i>dt</i> 174						Oxime, 201 Et eth, 60
262	<b>2-Aminotriphenylcarbinol</b>	121		192					122 3	
263	<b>3-Hydroxyaniline (3-Aminophenol)</b>	122		<i>mono</i> 148 <i>dt</i> 101	<i>N</i> -mono 174 198 204		157	156		
264	<b>2,4,6-Tribromoaniline</b>	122 119		232						<i>N</i> -Formyl 222
265	<b>4-Amino-2-hydroxyacetophenone</b>	122 3		<i>N</i> -mono 91						<i>N,N</i> -Di Me 120
266	<b>1-Aminoisoquinoline</b>	122 3							290 1	Hydrochloride, 233 Chloroplatinate, >300
267	<b>3,4,5-Tribromoaniline</b>	123		255 6	210					
268	<b>4,4'-Diamino-2,2'-dimethyldiphenylmethane</b>	123		228 ( <i>dt</i> )					216	
269	<b><i>cis</i>-2,2'-Diaminostilbene</b>	123, 107, red		214-5 ( <i>dt</i> )					155-6	Hydrochloride 230
270	<b>2,4-Dimethyl-5-nitroaniline</b>	123		159	200	149	192			
271	<b>2-Amino-4-nitrobenzaldehyde</b>	124								Oxime, 193 Semicarbazone, 390 Anil, 147, red <i>N</i> -Propionyl 139
272	<b>4-Aminobenzophenone</b>	124		153	152					
273	<b>7-Amino-8-hydroxyquinoline</b>	124, br		<i>N</i> -mono 177					205	
274	<b>2-Amino-5-nitrobiphenyl</b>	125, yel		133			169			
275	<b>3-Hydroxy-4-methoxyaniline (4-Aminoguaiacol)</b>	125 7		<i>N</i> -mono 116 9	<i>N,O</i> - <i>di</i> 162 4					
276	<b>2-Amino-1-nitronaphthalene (1-Nitro-2-naphthylamine)</b>	126, orange yel		123	168	156	160			
277	<b>4-Aminoazobenzene</b>	126		146	211					<i>N</i> -propionyl, 170
278	<b>Hydrazobenzene</b>	126 7		<i>mono</i> 159, <i>di</i> 105	<i>mono</i> 126, bz <i>di</i> 162					
279	<b>5-Chloro-2-nitroaniline</b>	126 5 gold-yel		121						<i>N</i> -Me, 107 <i>N,N</i> -Di-Me, 49
280	<b>Benzidine</b>	127		317 ( <i>dt</i> ) 199 ( <i>mono</i> )	352 ( <i>dt</i> ) 203 5 ( <i>mono</i> )	232 ( <i>dt</i> )	243 ( <i>dt</i> )			
281	<b>2-Aminopyrimidine</b>	127 8							237-8	Chloroplatinate, 216 Hydrochloride, 196
282	<b>2-Amino-6-bromonaphthalene (6-Bromo-2-naphthylamine)</b>	128		192	218					
283	<b>5-Bromo-2-hydroxyaniline (2-Amino-4-bromophenol)</b>	128, 88		177 9						Me eth, 97 8
284	<b>5-Aminoisoquinoline</b>	128							>200	Methodide, 228 Ethiodide, 216 Oxime, 151 2, Phenylhydrazone, 165
285	<b>2-Aminovanillin (2-Amino-4-hydroxy-3-methoxybenzaldehyde)</b>	128 9		97						
286	<b>2-Amino-3,7-dimethylnaphthalene (3,7-Dimethyl-2-naphthylamine)</b>	129, 134		231						Hydrochloride, 275
287	<b>4-Methoxy-2-nitroaniline (3-Nitro-<i>p</i>-anisidine)</b>	129, 123, dk red		117, yel	140					<i>N</i> -4-Nitrobenzoyl, 204
288	<b>2-Aminotriphenylmethane</b>	129		154 5						<i>N</i> -Me, 130-2

\*Derivative data given in order m.p. crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
289	2-Aminoquinoline	129							255-6	Methodide, 247, Ethio- dide, 232, 1,3,5-Trinitro- benzene add comp, 186, red
290	4,4'-Diamino-3,3'-dimethyl- biphenyl ( <i>o</i> -Tolidine)	129		<i>mono</i> 103 (hyd), <i>di</i> 315 <i>tetra</i> 211	198 ( <i>mono</i> ), 265 ( <i>di</i> )					N,N'-Di-formyl, 254 1 Naphthylthiourea, 167, 3-Nitrophthalimide, 185
291	2,4-Diaminodiphenylamine	130		188 ( <i>di</i> )	2- <i>mono</i> 213					
292	3-Aminocoumarin	130, yel		201 2	173					1-Naphthylthiourea 165
293	2-Methyl-4-nitroaniline (5-Nitro- <i>o</i> -toluidine)	130		202		158	174			
294	2-Amino-4-chloropyridine	130 1		115-6	<i>mono</i> 120; <i>di</i> 165				243	
295	4-Hydroxy-3-nitroaniline	131, 127, red		<i>N-mono</i> 157 8						N-Me, 113 Et eth, 40
296	4-Bromo-3-nitroaniline	131 2		146						N,N-Di-Me, 72
297	2-Aminobenzothiazole	132, 129		186	186				256	
298	2-Amino-4-methylquinoline	133	320						abt 250	N-Phenyl, 129, Chloro- platinate, 230
299	2,2'-Diaminobenzophenone	133, pa yel		168 (154) ( <i>di</i> )					164	
300	2,2'-Diaminoazobenzene	134, red		271 ( <i>di</i> )						
301	3,5-Dimethyl-2-hydroxyaniline	134-5		<i>N-mono</i> 96	154 (O,N- <i>di</i> )					N-Formyl, 68
302	2-Hydroxy-5-methylaniline (4-Hydroxy- <i>m</i> -toluidine)	135		<i>N-mono</i> 160, N,O- <i>di</i> 145 102	191, N,O- <i>di</i> 190					N-Propionyl, 95 6, N,O-Dipropionyl, 91 2
303	3-Methyl-4-nitroaniline (6-Nitro- <i>m</i> -toluidine)	135		102						2-Naphthylthiourea, 159
304	2-Amino-3-methylnaphthalene (3-Methyl-2-naphthylamine)	135		181-2	190					
305	2-Aminoacenaphthene	135							260, yel, eth	Hydrochloride, 270
306	DL-2,2'-Diamino-6,6'-dimethyl- biphenyl	136		205 ( <i>di</i> )	182 ( <i>di</i> )		162 3 ( <i>di</i> )			
307	1,4-Diamino-2-nitrobenzene (2-Nitro- <i>p</i> -phenylenediamine)	137, blk		1- <i>mono</i> 162, 4- <i>mono</i> 189, <i>di</i> 186	4- <i>mono</i> 236					1,4-Di-4-nitrobenzoyl, >305
308	9-Aminophenanthrene	137 8, 104		207 8	199				190	
309	4,4'-Diamino-3,3'-dimethoxy- biphenyl (Diamisidine)	137-8		242 ( <i>di</i> )	236 ( <i>di</i> )				225 ( <i>di</i> )	
310	3,5-Dimethyl-4-hydroxyaniline (5-Amino-2-hydroxy- <i>m</i> -xylene)	137-8		160 ( <i>di</i> )						Me eth, 66
311	2,6-Dinitroaniline	138		197						
312	2-(4-Aminophenyl)-quinoline	138		<i>mono</i> 189, <i>di</i> 154	234					Methodide, 220, N-Me, 82, N-Formyl, 160 Hydrochloride, 283
313	2-Amino-3,6-dimethylnaphthalene (3,6-Dimethyl-2-naphthylamine)	139		207						
314	2-Methoxy-4-nitroaniline (5-Nitro- <i>o</i> -anisidine)	139-40, pa yel		153-4	150	181	175, 170			
315	4-Aminopropiophenone	140		161	190					Oxime, 153
316	4-Amino-3-nitrobenzophenone	140, 135, yel			154 5					N,N-Di-Me, 116, N-Et, 100

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES  
1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenylthiourea	Picrate	Miscellaneous
317	2-Amino-4-methyldiphenylamine	140			161					Hydrochloride, 200
318	1,4-Diaminobenzene ( <i>p</i> -Phenylenediamine)	140, 147	267	<i>mono</i> 162 3 <i>di</i> 304	<i>mono</i> 128 <i>di</i> 300	247 ( <i>di</i> )	266 ( <i>di</i> )			3,5-Dinitrobenzoate, 178
319	2-Hydroxy-5-nitroaniline	142 3 (anh) 80-90 (hyd), or		220		>200	122 (O-)			Me eth 118 Et eth , 99
320	2-Amino-4-nitrostilbene	142 3, red		<i>N-mono</i> 220 yel, al						Hydrochloride, 219
321	5-Amino-8-hydroxyquinoline	143		<i>N-mono</i> 221 2, al, N,O- <i>di</i> 206 7, al	205 (O, N- <i>di</i> )					Me eth , 156, yel
322	1-Amino-2-nitronaphthalene (2-Nitro-1-naphthylamine)	144, red- yel		199	175					N-Et , 77, red
323	2-Amino-5-nitronaphthalene (5-Nitro-2-naphthylamine)	144, red		186	182					
324	5-Hydroxy-2-methylaniline (4-Hydroxy- <i>o</i> -toluidine)	144		<i>N-mono</i> 178 N,O- <i>di</i> 128		183 (N-)				
325	2,5-Dimethyl-4-nitroaniline (5-Nitro- <i>p</i> -2-xylydine)	144-5		168-9		162	185			
326	4-Amino-4'-bromobiphenyl	145		247			174			
327	1-Aminophenanthrene	146		220					204	
328	3,5-Dihydroxyaniline (5-Amino-resorcinol)	146-52		119 21 ( <i>tri</i> )						Di Me eth , 46 Picrate of Di-Me eth , 167-70 N,N'-Di-Me , 82, N-Et , 101
329	4-Amino-2-chlorobenzaldehyde	147, yel		152						1-Naphthylthiourea, 187
330	4-Nitroaniline	147 8, yel		215	199, 203 ( <i>di</i> )	139	191		100	
331	5-Amino-3-methyl-1,2,4-triazole	148		>270	285 90				225	
332	2,2'-Dihydroxyhydrazobenzene	148			186 ( <i>di</i> )					Di-Me eth , 102
333	7-Amino-2-methylquinoline (anh)	148			172 3				213-4	
334	4,4'-Diamino-2,2'-dimethyl azoxybenzene	148, gold- yel		281 ( <i>di</i> )	290					
335	4-Bromo-3-hydroxyaniline	150		210-2			135-6 (O-)			
336	3-Amino-1-phenyl-1,2,4-triazole	150		<i>3-mono</i> 168, 3,3- <i>di</i> 118					220	Hydrochloride, 187
337	4-Aminochalcone (4-Aminobenzalacetophenone)	151, golden		179						Oxime, 139
338	4-Aminopyrimidine	151-2		202					226	N-Me , 74-5, N-Phenyl, 142-3 N-Formyl, 217, N-Me , 60, N,N-Di-Me , 53-4
339	Pentamethylaniline	151-2	277-8	213						N-Me , 115, N-Et , 90
340	N-Methyl-4-nitroaniline	152		153	112	121				
341	5-Bromo-2-nitroaniline	152, red- yel		139						
342	3-Chloro-4-hydroxyaniline	153		<i>N-mono</i> 144, <i>di</i> 124			116-7 (O-)			Me eth , 62

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines c) Solids ( Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
343	4-Chloro-2-hydroxyaniline	154		140 ( <i>di</i> )						Hydrochloride, 226 7, Benzyl eth, 46 7 Me eth, 52
344	4-Aminoquinoline ( $\gamma$ -Aminoquinoline)	154 (anh)		178					274	Methiodide, 224, Ethiodide, 232
345	3-Aminobenzopyrazole	154		177 8 ( <i>di</i> )	182 ( <i>di</i> )					
346	2,5-Dihydroxy-4-nitroaniline (2-Amino-5 nitrohydroquinone)	154, red		<i>mono</i> 226 <i>di</i> 183 4						Di Me eth, 158
347	4-Hydroxy-2-nitroaniline	154, red		<i>N-mono</i> 218 <i>N O-di</i> 146						Me eth, 129 123
348	3-Aminotriphenylcarbinol	155		164						O,N,N-Trimethyl, 81
349	1-2,2'-Diamino-6,6-dimethylbiphenyl	156		205 ( <i>di</i> )	172 ( <i>di</i> )					
350	3,3'-Diaminoazobenzene	156 140, or -yel		272 ( <i>di</i> )	286 ( <i>di</i> )					
351	5-Amino-1-phenyl-1,2,4-triazole	157							175	Chloroplatinate, 197
352	4-Nitrophenylhydrazine	157, or -red		205	193				119 20	
353	4-Aminopyridine ( $\gamma$ -Aminopyridine)	158		150 (anh)	202					215 6
354	4,4'-Diamino-3,3'-dimethyldiphenylmethane	158 9		224 ( <i>di</i> ) 119 ( <i>tetra</i> )	215 ( <i>di</i> )					192-3
355	2-Amino-8-nitroquinoline	159		211	166				257	
356	3-Amino-1,2,4-triazole	159							231	Hydrochloride, 153
357	2-Amino-4'-nitrobiphenyl	159, or -red		199			163			
358	3-Amino-2-methylquinoline	159 60	270	165	161				235	N-Formyl, 163
359	1-Amino-4-hydroxy-3-nitronaphthalene (4-Hydroxy-3-nitro-1-naphthylamine)	160, maroon		250, 238	330					
360	2,4-Dihydroxy-5-nitroaniline	160-1, red		<i>N-mono</i> 261 <i>tri</i> 176						Di-Me eth, 136 7
361	1,3-Diamino-4-nitrobenzene (4-Nitro- <i>m</i> -phenylenediamine)	161 157, yel red		<i>1-mono</i> 200 1,3- <i>di</i> 246	222 ( <i>di</i> )		169 ( <i>di</i> )			N,N,N',N'-Tetramethyl, 81
362	3-Hydroxy-4-methylaniline (2-Hydroxy- <i>p</i> -toluidine)	161		<i>N-mono</i> 225 <i>di</i> 132 3			111-2 (O-)			N-Chloroacetyl, 154 5
363	2-Hydroxy-4-methylaniline (3-Hydroxy- <i>p</i> -toluidine)	162		<i>N-mono</i> 171	<i>N-mono</i> 169, <i>N,O-di</i> 162					
364	4-Aminoacetanilide	162		304						
365	3-Hydroxy-4-nitroaniline	162, 158, or -yel		<i>N-mono</i> 221, <i>N,O-di</i> 149						Me eth, 169, 161
366	2,4-Dimethyl-6-hydroxyaniline	163		<i>mono</i> 186 7, <i>di</i> 87 8	<i>N-mono</i> 211, <i>N,O-di</i> 148 9					Me eth, 150
367	2-Aminofluorenone	163, vlt -red		227						Hydrazone, 209, N-Car-bethoxy, 167 8
368	1-(2-Aminoethyl)-4-hydroxybenzene (4-(2-Aminoethyl)phenol, Tyramine)	164			<i>N-mono</i> 162, <i>di</i> 172				206	

\*Derivative data given in order m p, crystal color, solvent from which crystallized



TABLE XVIII. ORGANIC DERIVATIVES OF AMINES  
1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
369	4-Aminophenacyl alcohol	165, yel		<i>N</i> -mono 176 7, <i>O</i> - <i>mono</i> 130 <i>N,O</i> - <i>di</i> 162	188 ( <i>O</i> -)					Phenylhydrazone, 199
370	3-Bromo-4-hydroxyaniline	165 155, pa br		<i>N</i> -mono 157	<i>N</i> -mono 184 5, <i>di</i> 192					
371	2,7-Diaminonaphthalene	166		261 ( <i>di</i> )	267 ( <i>di</i> )				210 ( <i>di</i> )	
372	4-Amino-4'-iodobiphenyl	166-7, 159 yel								<i>N</i> -Benzal, 209, <i>N</i> -Piperonyldine, 150 1, Hydrochloride, 295 <i>N</i> -Me, 112
373	4-Amino-3-nitrobiphenyl	167, red		132	143					
374	1,2-Diamino-4-hydroxybenzene (3,4-Diaminophenol)	167-8		1,2- <i>di</i> 205 7	1,2- <i>di</i> 203 <i>tri</i> 225					
375	4,4'-Diaminotriphenylcarbinol	168 s h, 175 r h		4,4'- <i>di</i> 267						Me eth, 162
376	4-Amino-2-phenylquinoline	168		108, 117 ( <i>di</i> )	182					Methodide, 274, Ethio- dide, 244, <i>N</i> -Formyl, 275
377	2,6-Dinitro-4-methylaniline	168, 172		195	186					
378	4-Amino-2-methylquinoline	168	333						197 9	<i>N</i> -Phenyl, 150, Chloro- platinate, 223 <i>N</i> -Formyl, 175-6
379	6-Aminocoumarin	168-70, yel		216-7	173	159				
380	Picramic acid (3,5-Dinitro-2- hydroxyaniline)	169, red		<i>N</i> -mono 201, <i>O</i> - 193	<i>N</i> -mono 300 <i>O</i> - 218		191			
381	3,3'-Diaminobenzophenone	173, yel		226-7 ( <i>di</i> )						Oxime, 177-8
382	4,5-Dimethyl-2-hydroxyaniline	173 5		<i>N</i> -mono 191, <i>N,O</i> - <i>di</i> 157	<i>N</i> -mono 195 6, <i>N,O</i> - <i>di</i> 152 3					
383	2-Hydroxyaniline	174		<i>mono</i> 209 201, <i>di</i> 124	<i>N</i> -mono 165 <i>O</i> - 185	141	146			
384	4-Hydroxy-3-methylaniline	175		<i>N</i> -mono 179	<i>N,O</i> - <i>di</i> 194		109-10 ( <i>O</i> -)			
385	6-Amino-5,7-dimethylquinoline	175	> 300	212					182	
386	4,4'-Diaminodiphenyl sulfone	175-6		286 ( <i>di</i> )						<i>N,N'</i> -Di-Me, 179-80, <i>N,N</i> -Tetramethyl, 260
387	<i>trans</i> -2,2'-Diaminostilbene	176, 168, gold- yel		304 ( <i>di</i> )					209	Hydrochloride, 267
388	6-Amino-5-nitroquinoline	178, 174, yel					168		270	
389	6-Aminothymol	178 9		<i>N</i> -mono 74, <i>tri</i> 91	<i>N</i> -mono 178-9, <i>N,O</i> - <i>di</i> 166 7					Oxid → thymoquinone, 45 5
390	4-Hydroxy-2-methylaniline (5-Hydroxy- <i>o</i> -toluidine)	179		<i>N</i> -mono 130	92 ( <i>O</i> -)					Hydrochloride, 215
391	2,4-Dinitroaniline	180, 188		120	202, 220		219			
392	1-Amino-4-chloroanthraquinone	180, red		203-4						<i>N,N</i> -Di-Me, 172
393	2,6-Dimethyl-4-hydroxyaniline	181		178-80						<i>N</i> -Benzal, 104-5, <i>N</i> -Me, 43, <i>N</i> -Et, 161-2
394	4-Amino-2,6-dimethylpyrimidine	183							214	<i>N</i> -Phenyl, 104
395	4-Aminobenzamide	183, yel		275						<i>N</i> -Chloroacetyl, 241 3

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
396	4-Hydroxyaniline (4-Aminophenol)	184, 186		150 ( <i>di</i> ), 168 ( <i>mono</i> )	<i>N</i> - <i>mono</i> 216-7, <i>N,O</i> - <i>di</i> 234	125	<i>N</i> - <i>mono</i> 252-4, O- 142	150		3,5-Dinitrobenzoate, 178
397	1-Amino-3-hydroxynaphthalene (3-Hydroxy-1-naphthylamine)	185		<i>N</i> - <i>mono</i> 179	309 (O, <i>N</i> - <i>di</i> )		137 (O-)			
398	5-Hydroxy-2-nitroaniline	185 6, or		<i>N</i> - <i>mono</i> 266						Me eth, 131, br, Et eth, 105, yel
399	6,6'-Diamino-3,3'-dimethyltriphenylmethane	185-6	430, part d	217 ( <i>di</i> )	196 ( <i>di</i> )					
400	4-Amino-2,6-dimethylpyridine	186	246	113					194 5	Chloroplatinate, 250
401	4-Amino-4'-hydroxyazobenzene	186		<i>N</i> - <i>mono</i> 203 <i>di</i> 236 7						<i>N,N</i> -Di-Me, 203
402	4-Amino-4'-methylbenzophenone	186 7		155						Phenylhydrazone, 163
403	6-Amino-2-methylquinoline	187-8		168 9						<i>N</i> -Cinnamoyl, 257
404	4-Amino-2,6-diethyl-5-methylpyrimidine (Cyanethine)	189	280 d	59						
405	2,4,6-Trinitroaniline (Picramide)	190		230	196	211				
406	1-Amino-6-hydroxynaphthalene (6-Hydroxy-1-naphthylamine)	190 185		<i>N</i> - <i>mono</i> 218, <i>N,O</i> - <i>di</i> 187	<i>N</i> - <i>mono</i> 152 <i>N,O</i> - <i>di</i> 223				170	
407	4,4'-Diaminoazoxybenzene	190, yel		275						Sn + HCl → 1,4-Diaminobenzene, 147
408	4-Amino-3-nitrobenzaldehyde	191, yel		155						Phenylhydrazone, 202, Oxime, 207 4-Nitrophenylhydrazone, 270-2
409	2-Amino-1,5-dinitronaphthalene (1,5-Dinitro-2 naphthylamine)	191		201			182			
410	DL-2,2'-Diamino-1,1'-dinaphthyl	193		235 6 ( <i>di</i> )	235 ( <i>di</i> )				185	
411	8-Amino-6-nitroquinoline	194, red		224						Chloroplatinate, 180, Methiodide, 176
412	1-Amino-4-nitronaphthalene (4-Nitro-1-naphthylamine)	195		190	224	173, 158	185			
413	2-Amino-4,6-dimethylpyrimidine	197							230	Hydrochloride, 181, Chloroplatinate, 225, <i>N</i> -Me, 98
414	4,6-Diamino-2-methylquinoline	197		6- <i>mono</i> 250						6- <i>N</i> -Cinnamoyl, 253-4, 4- <i>N</i> -Et, 195, 6- <i>N</i> -Et, 232 <i>N,N'</i> -Di-Me, 172
415	1,2-Diamino-4-nitrobenzene (4-Nitro- <i>o</i> -phenylenediamine)	198, red		1 <i>mono</i> 205 2 <i>mono</i> 195	235 ( <i>di</i> )					
416	2,4-Dinitrophenylhydrazine	199 200		197 8	206-7					
417	2-Hydroxy-5-methyl-4-nitroaniline	200, yel		<i>N</i> - <i>mono</i> 242						Me eth, 132, <i>N</i> -Acetyl of Me eth, 156
418	4-Amino-3-nitropyridine	200, yel							197 8	Hydrochloride, 258-9, Chloroplatinate, 256
419	4-Amino-4'-nitrobiphenyl	200, red		264, 240, yel		174, yel				
420	2-Amino-5-nitrobenzaldehyde	200, yel		160-1			181-2			Oxime, 203 <i>N,N</i> -Di-Me 105, yel
421	2-Amino-7-hydroxynaphthalene (7-Hydroxy-2-naphthylamine)	201		<i>N</i> - <i>mono</i> 232, <i>N,O</i> - <i>di</i> 156	<i>N</i> - <i>mono</i> 243 6, <i>N,O</i> - <i>di</i> 181					
422	2-Amino-1-bromo-3-methylanthraquinone	202, 204			<i>di</i> 243 4, pa yel, al					

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES  
 1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	Acetamide	Benzamide	Benzene sulfon amide	<i>p</i> -Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
423	4,4'-Diamino-1,1'-dinaphthyl	202		363 ( <i>di</i> )	320 ( <i>di</i> )				147	
424	4,4',4''-Triaminotriphenylmethane	203		201 ( <i>tri</i> )						1,3,5-Trinitrobenzene add comp, 140, blk Oxime, 201 2
425	Isatin	204		141						
426	3-Amino-5-phenylacridine	204		256	246					
427	2-Amino-1,4-naphthoquinone	204 5, or -red		202						N-Phenyl, 191
428	1-Amino-2-methylantraquinone	205, red		<i>mono</i> 176 7, <i>di</i> 203-6			218			
429	4,4',4''-Triaminotriphenylcarbinol (Pararosaniline)	205		192 ( <i>tri</i> )						Me eth, 135
430	1-Amino-7-hydroxynaphthalene (7-Hydroxy-1-naphthylamine)	205 7		<i>N-mono</i> 165	<i>N-mono</i> 208-9, <i>N,O-di</i> 208					
431	4,6-Diaminoisophthalaldehyde	208		270 ( <i>mono</i> ), 280 ( <i>di</i> )						Dioxime, 220, Diphenylhydrazone, 337
432	N-4-Hydroxybenzylaniline	208								Me eth, 65, Et eth, 65
433	6-Aminobenzopyrazole	210		248 (6-N-), 184-5 ( <i>di</i> )						Dihydrochloride, 230
434	4,4'-Diamino-2,5,2',5'-tetramethyltriphenylmethane	210		217 ( <i>di</i> )	250 ( <i>di</i> )					
435	3-Indolylpyruvic acid	211, grey								4-Nitrophenylhydrazone, 153-4, Oxime, abt 175
436	2-Amino-6-hydroxynaphthalene (6-Hydroxy-2-naphthylamine)	212 3			<i>N,O-di</i> 228 30					Me eth, 78 Et eth, 91
437	5-Amino-1,4-dihydroxyanthraquinone (5-Aminoquinizarin)	212 3, br red								N-Phenyl, 223, Di-Me eth, 242-3
438	2-Amino-4,5-dimethylpyrimidine	214 5							250	Chloroplatinate, 227
439	5-Bromo-4-hydroxy-2-methylaniline	215, 205		171 2 ( <i>di</i> )	229 ( <i>di</i> )					
440	4-Amino-4'-nitroazobenzene	216 205		245						N-Me, 206 7, bl
441	2-Hydroxy-6-nitroaniline	216, red		<i>N-mono</i> 172			136 (O-)			Me eth, 76
442	3,4-Diaminopyridine	218 9			222 3 ( <i>di</i> )				235-7	Chloroplatinate, 231
443	1-Amino-5-chloroanthraquinone	219, red		219	218					
444	3,6-Dimethylcarbazole	219		129					192	N-Nitroso, 106
445	3-Aminothioxanthone	221-2, yel -br		236 7						Hydrochloride, 230
446	2-Amino-10-hydroxyphenanthrene	221		182 (O, <i>N-di</i> )	225 (O, <i>N-di</i> )					
447	5-Amino-4-nitroacenaphthene	222, red		252	233					N-Formyl, 227
448	5-Chloro-4-hydroxy-2-methylaniline	223 5, 204 5		162 ( <i>di</i> )	220 ( <i>di</i> )					
449	2,6-Dimethylcarbazole	224							162	N-Nitroso, 113
450	2-Amino-1,8-dinitronaphthalene (1,8-Dinitro-2-naphthylamine)	226		238			221			
451	<i>trans</i> -4,4'-Diaminostilbene	231, yel		353 ( <i>di</i> )	352 ( <i>di</i> )					
452	2-Amino-3-hydroxynaphthalene (3-Hydroxy-2-naphthylamine)	234		188 (O, <i>N-di</i> )	<i>N-mono</i> 233-5					
453	1-Amino-2,4-dinitronaphthalene (2,4-Dinitro-1-naphthylamine)	242		259	252		166			
454	2,5-Dimethyl-4-hydroxyaniline	242		177-9						Et eth, 69 70
455	1-Amino-3-bromoanthraquinone	243, red		214			227			
456	4,4'-Diaminobenzophenone	244		237 ( <i>di</i> )						Phenylhydrazone, 240
457	Carbazole	246		69	98				185	
458	1-Amino-2-hydroxyanthraquinone	250, br		<i>N-mono</i> 170						Et eth, 182, red

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
459	1-Aminoanthraquinone	252, 243		218	255		228 9			
460	3-Aminocarbazole	254		3- <i>mono</i> 217, <i>di</i> 200, <i>tri</i> 175	3- <i>mono</i> 250					
461	2,7-Diaminocarbazole	260		320 ( <i>di</i> )						N,N'-Dibenzal, 290
462	1,8-Diaminoanthraquinone	262, red		284 ( <i>di</i> )	324 ( <i>di</i> )					
463	1,4-Diaminoanthraquinone	268, vlt		271 ( <i>di</i> )	284 ( <i>di</i> ), 280 ( <i>mono</i> )					
464	2-Amino-3-nitrofluorenone	269, vlt		245 6						N-Carboethoxy, 204
465	1,1'-Diamino-2,2'-dinaphthyl	281		230 ( <i>di</i> )	278 ( <i>di</i> )					
466	1,7-Diaminoanthraquinone	290, red		283 ( <i>di</i> )	325 ( <i>di</i> )					
467	2,7-Diaminofluorenone	290, vlt		222 ( <i>di</i> )					230 ( <i>di</i> )	Oxime, 255, Phenylhydrazone, 230, 4-Nitrophenylhydrazone, 280
468	1,6-Diaminoanthraquinone	292, red		295 ( <i>di</i> )	275 ( <i>di</i> )					
469	1-Amino-5-nitroanthraquinone	293, red		275	237					N-Me, 250 2, vlt- blk, N-Et, 238 N-Me, 250
470	1-Amino-4-nitroanthraquinone	296, yel - red		256 8						
471	5,8-Diaminoquinizarin (1,4-Diamino-5,8-dihydroxyanthraquinone)	>300, br -vlt		5,8- <i>di</i> 284		5,8- <i>di</i> 275				
472	2-Aminoanthraquinone	305 8, 302		<i>mono</i> 262, <i>di</i> 258	228	271	304			
473	2-Amino-3-bromoanthraquinone	307, or -yel		259 217	279					N-Benzal, 174
474	2-Aminoquinizarin (2-Amino-1,4-dihydroxyanthraquinone)	313 4, grn -yel								N-Phenyl, 255 6, N-4-Tolyl, 220
475	1,5-Diaminoanthraquinone	319, red		317 ( <i>di</i> )	>350 ( <i>di</i> )					
476	2,7-Diaminoanthraquinone	>330, or		>350	300 ( <i>di</i> )					
477	2,5-Dianilino-1,4-benzoquinone	345, red-br								Anil, 203, Diamil, 240, red
478	2,8-Diaminoacridone	>350		>350 ( <i>di</i> )	>250 ( <i>di</i> )					N,N'-Dibenzal, 370

\*Derivative data given in order m p crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES  
2. Tertiary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point °C	Melting point, °C	$n_D$	Density g/ml	Methyl <i>p</i> -toluene sulfonate	Methiodide	Picrate	Chloro platinate	Miscellaneous
1	Trimethylamine	3			0.6709 <sup>0</sup>		230	216, 225		<i>p</i> -Toluenesulfonate salt, 162
2	Dimethyl ethyl amine	37.5						193		Hydrochloride, 221
3	N-Methylpyrrolidine	78-80						221	233	
4	Triethylamine	89		1.400 <sup>20</sup>	0.7255 <sup>15</sup>			173		2,4-Dinitrobenzoate salt, 81 3,β-Resorcylic acid salt, 120
5	1,2-Dimethylpyrrolidine	96		1.4252 <sup>20</sup>	0.7994 <sup>20</sup>			235	223	
6	1,3-Dimethylpyrrolidine	96-7			0.792 <sup>1</sup>			dimorphous, 181 or 110-5	58.9	HgCl <sub>2</sub> add comp., 200
7	Pyridine	116		1.5092 <sup>21</sup>	0.978 <sup>25</sup>	139	117	167	241, 262.4	<i>p</i> -Toluenesulfonate salt, 160, Ethiodide, 91
8	1,2,5-Trimethylpyrrolidine	116		1.4335 <sup>9,2</sup>	0.815 <sup>4</sup>		310	163		
9	2-Dimethylaminoethyl ether	121		1.406 <sup>20</sup>	0.806 <sup>20</sup>		160.5	119-21		
10	Dimethylaminoacetone	123							176, s. h.	Oxime, 99
11	1-Methylpyrazole	127		1.4787 <sup>14</sup> <sub>He</sub>	0.993 <sup>14</sup>		190	148	196.8	
12	N-Ethylpiperidine	128		1.4416 <sup>20</sup> <sub>α</sub>	0.8237 <sup>20</sup>			167.5	202	
13	2-Methylpyridine (α-Picoline)	129		1.503 <sup>17</sup>	0.9497 <sup>15</sup>	150	230	169	216, 195	<i>p</i> -Toluenesulfonate salt, 161, Ethiodide, 123
14	β-Dimethylaminoethyl alcohol (2-Dimethylaminoethyl alcohol)	135		1.43 <sup>20</sup>	0.8866 <sup>20</sup>			96.7		
15	1,3-Dimethylpyrazole	136		1.467 <sup>15</sup> <sub>α</sub>	0.9628 <sup>15</sup>		256	138		
16	2-Methylpyrazine	136-7			1.029 <sup>20</sup>		129.30	133		
17	4-Methylpyrimidine	141.2			1.031 <sup>18</sup>			131.4		HgCl <sub>2</sub> double salt, 198
18	2,6-Dimethylpyridine (2,6-Lutidine)	142.3					233	168	208	
19	3-Methylpyridine (β-Picoline)	143		1.504 <sup>44</sup>	0.9515 <sup>25</sup>			150	202	Styphnate, 154, Oxid → nicotinic acid, 228
20	4-Methylpyridine (γ-Picoline)	143		1.506 <sup>19</sup>	0.957 <sup>15</sup>			167	231	β-Resorcylic acid salt, 125
21	4-Chloropyridine	147.8							202	
22	2-Ethylpyridine	149			0.9371 <sup>17</sup>			187.9	165.7	
23	3-Chloropyridine	149						135	168	
24	Tri- <i>n</i> -propylamine	156.5		1.4176 <sup>20</sup>	0.753 <sup>20</sup>		207.8	116		Ethiodide, 238
25	2,4-Dimethylpyridine (2,4-Lutidine)	157, 159		1.503 <sup>14</sup>	0.9273 <sup>25</sup>			183	216	β-Resorcylic acid salt, 143
26	2,5-Dimethylpyridine (2,5-Lutidine)	160						169	192.4	
27	1,3,4-Trimethylpyrazole	160		1.4866 <sup>18</sup> <sub>He</sub>	0.956 <sup>18</sup>			164		
28	3-Ethylpyridine	162-4			0.954 <sup>0</sup>			128-30	208-9, 196	
29	β-Diethylaminoethyl alcohol (2-Diethylaminoethyl alcohol)	163		1.440 <sup>25</sup>	0.8601 <sup>25</sup> <sub>25</sub>					4-Nitrophenylurethane, 60
30	Tropidine (2-Tropene)	163		1.4884 <sup>19</sup> <sub>α</sub>	0.953 <sup>20</sup>		abt 300	285	217	
31	2,3-Dimethylpyridine (2,3-Lutidine)	164						188	195	
32	3,4-Dimethylpyridine (3,4-Lutidine)	164						163	205	
33	4-Ethylpyridine	164-5			0.9417 <sup>20</sup>			168	213	
34	2,4,5-Triethylpyridine (2,4,5-Collidine)	165-8						128-31	205	
35	1,4-Bis-dimethylaminobutane	167						199		
36	Tropane	167			0.931 <sup>20</sup>		>300	281	230	
37	1-Diethylaminoisopropyl alcohol	167.72			0.8511 <sup>20</sup>			89		
38	2-Chloropyridine	170, 166			1.205 <sup>15</sup>	120				
39	3-Bromopyridine	170		1.5694 <sup>20</sup>	1.645 <sup>9</sup>	156	165		175	
40	3,5-Dimethylpyridine (3,5-Lutidine)	170-1						245	255	

\*Derivative data given in order. m. p., crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES  
2. Tertiary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_D$	Density g/ml	Methyl <i>p</i> toluene sulfonate	Methiodide	Picrate	Chloro platinate	Miscellaneous
41	2,4,6-Trimethylpyridine (2,4,6-Collidine)	172			0.917 <sup>20</sup>			156	223	
42	1,4,5-Triethylpyrazole	176-7		1.4848 <sup>18</sup> <sub>H<sub>2</sub>O</sub>	0.9685 <sup>18</sup>			175.6		
43	2,3,6-Trimethylpyridine (2,3,6-Collidine)	176.8						146	250.2	
44	Benzyl dimethyl amine	181						93	192	Picrolonate, 151
45	2,3,5-Trimethylpyridine (2,3,5-Collidine)	184						183, 179	227.8	
46	N,N,2-Trimethylaniline (N,N-Dimethyl <i>o</i> -toluidine)	185		1.515 <sup>20</sup>	0.9286 <sup>20</sup>			122, 116		1,3,5-Trinitrobenzene add comp., 113
47	2,6-Dimethyl-4-ethylpyridine	186			0.916 <sup>14</sup>			119-20	210	
48	2,4-Diethylpyridine	187-8			0.9338 <sup>9</sup>			98.100	170-1	
49	3-Diethylaminopropyl alcohol	190					175			
50	Methyl 2-pyridyl ketone	192					161	131	220	Oxime, 121 Phenylhydrazone, 155, Ethiodide, 205
51	2,3,4-Trimethylpyridine (2,3,4-Collidine)	192-3			0.912 <sup>15</sup>			163.4	259	
52	N,N-Dimethylaniline	193	2.2.5	1.5582 <sup>20</sup>	0.9557 <sup>20</sup>	161	228, 220	163	173	<i>p</i> -Toluenesulfonate salt, 133, 3,5-Dinitrobenzoate salt, 115
53	2-Bromopyridine	194			1.657 <sup>15</sup>	127				
54	3-Ethyl-4-methylpyridine	195.6			0.9656 <sup>9</sup>			148.50	234, 205	
55	3,5-Dimethyl-2-ethylpyridine	198						152	189	
56	N,N,2,6-Tetramethylaniline (N,N-Dimethyl- <i>m</i> -2-xylylidine 2-Dimethylamino- <i>m</i> -xylene)	199-200		1.513 <sup>20</sup>	0.912 <sup>20</sup>					1,3,5-Trinitrobenzene add comp., 108
57	N-Ethyl-N-methylaniline	201			0.919 <sup>55</sup>		125	134.5		Hydrochloride, 114
58	N,N,2,5-Tetramethylaniline (N,N-Dimethyl- <i>p</i> -2-xylylidine, 2-Dimethylamino- <i>p</i> -xylene)	204						158	196	
59	N,N,2,4-Tetramethylaniline (N,N-Dimethyl- <i>m</i> -4-xylylidine, 4-Dimethylamino- <i>m</i> -xylene)	205		1.5201 <sup>20</sup>	0.9164 <sup>20</sup>			123.4	219	1,3,5-Trinitrobenzene add comp., 114
60	N,N-Diethyl-2-methylaniline (N,N-Diethyl- <i>o</i> -toluidine)	206, 210					224	180		
61	2-Chloro-N,N-dimethylaniline	207						152	132	
62	N,N,4-Trimethylaniline (N,N-Dimethyl- <i>p</i> -toluidine)	210		1.536 <sup>20</sup>	0.929 <sup>20</sup>	85		219	129	1,3,5-Trinitrobenzene add comp., 124, vlt
63	3,4-Diethylpyridine	211						139	221	
64	Tri- <i>n</i> -butylamine	211, 216			0.778 <sup>20</sup>			180	106	$\beta$ -Resorcylic acid salt, 121
65	N,N,3-Trimethylaniline (N,N-Dimethyl- <i>m</i> -toluidine)	212		1.5492 <sup>20</sup>	0.941 <sup>20</sup>		177			
66	Methyl 4-pyridyl ketone	212-4						130	205	Oxime, 142, Phenylhydrazone, 150, HgCl <sub>2</sub> double salt, 183-4
67	N,N-Diethylaniline	218, 216			0.9351 <sup>20</sup>		102	142		
68	Methyl 3-pyridyl ketone	220								Oxime, 133, Phenylhydrazone, 137, HgCl <sub>2</sub> double salt, 158
69	N,N-Diethyl-4-methylaniline (N,N-Diethyl- <i>p</i> -toluidine)	229			0.924 <sup>16</sup>		184			
70	2,3,4,5-Tetramethylpyridine	232.4						170.2	210	
71	Quinoline	239	-15.6	1.6268 <sup>20</sup>	1.0929 <sup>20</sup>	126	133	203	227, 218	<i>p</i> -Toluenesulfonate salt, 155, Ethiodide, 159, Styphnate, 207.8
72	Isoquinoline	243	26, 24	1.615 <sup>20</sup> , 1.622 <sup>25</sup>	1.0986 <sup>20</sup>	163	159	222	263	Ethiodide, 148

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**2. Tertiary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	$n_D$	Density g/ml	Methyl <i>p</i> -toluene sulfonate	Methiodide	Picrate	Chloro platinate	Miscellaneous
73	<b>DL-Nicotine</b> (DL-1-Methyl-2-(3-pyridyl)-pyrrolidine)	243			1 008 <sub>4</sub> <sup>20</sup>		219	218	abt 280	
74	<b>2-Dimethylaminobenzaldehyde</b>	244, yel					164		205 6	Oxime, 87, <i>p</i> -Nitrophenylhydrazone, 191
75	<b>Tri-isoamylamine</b>	245, 237			0 786 <sub>4</sub> <sup>20</sup>			125		
76	<b>N,N-Dipropylaniline</b>	245			0 9104 <sup>20</sup>		156	261		
77	<b>2-Ethylquinoline</b> ( $\alpha$ -Ethylquinoline)	245-6		1 598 <sup>23</sup>	1 050 <sup>17</sup>		180	148	188	
78	<b>2-Methylquinoxaline</b>	245-7						215	> 250	
79	<b>1-Methylindole</b>	247, 239			1 0707 <sup>0</sup>			150		
80	<b>2-Methylquinoline</b> (Quinaldine)	247		1 6126 <sup>20</sup>	1 0585 <sub>4</sub> <sup>20</sup>	161, 134	195	191, 195	228	$\beta$ -Resorcylic acid salt, 145 Ethiodide, 233
81	<b>8-Methylquinoline</b>	248		1 616 <sup>20</sup>	1 072 <sub>4</sub> <sup>21</sup>			200		
82	<b>L-Nicotine</b> (L-1-Methyl-2-(3-pyridyl)-pyrrolidine)	248		1 528 <sup>20</sup>	1 0097 <sub>4</sub> <sup>20</sup>			218	275	$[\alpha]_D^{20}$ - 167-8
83	<b>1-Ethylisoquinoline</b>	250						207 10	200	
84	<b>2,4-Dimethyl-5,6,7,8-tetrahydroquinoline</b>	250	20	1 5415 <sup>20</sup>	1 0043 <sub>4</sub> <sup>20</sup>		157	144		Hydrochloride, 195
86	<b>N-Methyl-2-pyridone</b>	255						145	141	Styphnate, 162
87	<b>4,6-Dimethylquinoline</b>	255 6, 280						236-7	238	
88	<b>3-Ethylisoquinoline</b>	257						171 2	180	
89	<b>Tri-<i>n</i>-amylamine</b> (Tri- <i>n</i> -pentylamine)	257, 245				80				
90	<b>3-Methylquinoline</b> ( $\beta$ -Methylquinoline)	257 9	16 7	1 6171 <sup>20</sup>	1 0673 <sub>4</sub> <sup>20</sup>		221	187	249	Ethiodide 220
91	<b>6-Methylquinoline</b>	258		1 6157 <sup>20</sup>	1 0654 <sub>4</sub> <sup>20</sup>	154	219, 216	229		
92	<b>3-Chloroquinoline</b> ( $\beta$ -Chloroquinoline)	258 60					276 subl	182	> 300	
93	<b>3-Bromo-N,N-dimethylaniline</b>	259	11					135		
94	<b>5-Methylquinoline</b>	260					105	210 3		
95	<b>4-Methylquinoline</b> ( $\gamma$ -Methylquinoline)	261-3			1 0862 <sup>20</sup>		173 4	210-1	226 30	Ethiodide, 141 3
96	<b>2,4-Dimethylquinoline</b>	264-5			1 061 <sup>15</sup>		263 5	193-4	229	Ethiodide, 214
97	<b>2-Phenylpyridine</b>	268-9						175	204	
98	<b>6,8-Dimethylquinoline</b>	269			1 066 <sup>4</sup>			288-9	235	
99	<b>N,N-Di-<i>n</i>-butylaniline</b>	271				180		125		
100	<b>4-Ethylquinoline</b> ( $\gamma$ -Ethylquinoline)	272-4					149	178-80	204	
101	<b>N,N-Dimethyl-1-aminonaphthalene</b> (N,N-Dimethyl- $\alpha$ -naphthylamine)	273		1 624 <sup>15</sup>	1 0446 <sub>13</sub> <sup>15</sup>			145		1,3,5-Trinitrobenzene add comp, 105 7
102	<b>5,8-Dimethylquinoline</b>	273 5	4 5		1 072 <sup>21</sup>			198	234	
103	<b>3-Bromoquinoline</b> ( $\beta$ -Bromoquinoline)	274 6	12					190		Oxalate, 107
104	<b>3,5-Dimethyl-1-phenylpyrazole</b>	275					190	103	186	
105	<b>6-Bromoquinoline</b>	278	19, 24				278	217		
106	<b>2,4,7-Trimethylquinoline</b>	280-1		1 5973 <sup>24</sup>	1 0337 <sup>20</sup>		322	232	272	
107	<b>4,7-Dimethylquinoline</b>	283						224	227	
108	<b>3,4-Dimethyl-1-phenylpyrazole</b>	285		1 5724 <sup>20</sup>	1 0574 <sub>4</sub> <sup>20</sup>			122 5	180	
109	<b>8-Chloroquinoline</b>	288					165		235	
110	<b>2,3'-Bipyridyl</b>	289, 298						150, <i>dt</i> 165-8		
111	<b>8-Bromoquinoline</b>	302-4					281		230	
112	<b>6-Methoxyquinoline</b>	305d	20, 28				236	305		
113	<b>N-Benzyl-N-methylaniline</b>	306		1 601 <sup>20</sup>	1 0422 <sub>28</sub> <sup>28</sup>		164	127		

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**2. Tertiary amines a) Liquids (b.p. at reduced pressure only)**  
**2) (Listed in order of increasing m.p. of the corresponding picrate derivative)\***

No	Name	Boiling point, °C	Melting point, °C	$n_D$	Density g/ml	Methyl <i>p</i> -toluene sulfonate	Methiodide	Picrate	Chloroplatinate	Miscellaneous
1	<b>N,N-Dimethyl-2-nitroaniline</b>	151 <sup>30-3</sup> , or -yel		1.6102				102.3		Hydrochloride, 174. 1,3,5-Trinitrobenzene add comp., 112
2	<b>2,6-Diethylpyridine</b>	71 <sup>317</sup>					142	115	211.2	
3	<b>2-Iodopyridine (<math>\alpha</math>-Iodopyridine)</b>	93 <sup>13</sup>		1.6366 <sup>20</sup>	1.9735 <sup>60</sup>		207	120	210	
4	<b>1,3-Dimethyl-1,2,3,4-tetrahydroquinoline</b>	130 <sup>217</sup>					204	131		
5	<b><math>\beta,\beta</math>-Diethylphenylhydrazine</b>	110 <sup>214</sup>						131		Reduces Fehling's and Tollen's reagent. Zn + AcOH $\rightarrow$ aniline, b.p. 184 + diethylamine b.p. 56
6	<b>3-Dimethylaminobenzaldehyde</b>	138 <sup>o</sup> , yel					185.6	147	168 r h	Oxime, 75-6. Semicarbazone, 229. <i>p</i> -Nitrophenylhydrazone, 188
7	<b>4-Methyl-5,6,7,8-tetrahydroquinoline</b>	122 <sup>11</sup>					183	170		Hydrochloride, 203
8	<b>3-Methyl-5,6,7,8-tetrahydroquinoline</b>	126 <sup>717</sup>					162	171	219	
9	<b>3-Ethylquinoline (<math>\beta</math>-Ethylquinoline)</b>	135 <sup>812</sup>		1.603 <sup>18</sup>	1.0508 <sup>20</sup>		191	197		Hydrochloride, 173
10	<b>4-Bromopyridine (<math>\gamma</math>-Bromopyridine)</b>	27.5 <sup>30<sup>o</sup> 3-0.5</sup>	0-1	1.5679 <sup>20</sup>				223		Decomposes to yel.-br solid on standing

\*Derivative data given in order m.p., crystal color, solvent from which crystallized



TABLE XVIII. ORGANIC DERIVATIVES OF AMINES  
2. Tertiary amines b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Methyl <i>p</i> -toluene sulfonate	Metho- dide	Pcrate	Chloro platinate	Miscellaneous
1	Pyrimidine	21	123 4			156		Chloraurate, 226
2	4,6-Dimethylpyrimidine	25	160			12 34	103 4	
3	2,8-Dimethylquinoline	27	252		221	180		n <sub>D</sub> 1 6022, Ethiodide, 229
4	4-Bromoquinoline (γ-Bromoquinoline)	29 30, 25	270d		265 70			
5	Quinoxaline (Benzopyrazine)	30	230		176			D <sub>4</sub> <sup>a</sup> 1 1334, n <sub>D</sub> <sup>b</sup> 1 6231, Oxalate, 169, Ethiodide, 146
6	5-Methylpyrimidine	30 5	154			141		HgCl <sub>2</sub> double salt, 246, Chloraurate, 209
7	4-Chloroquinoline (γ-Chloroquinoline)	31	263			212	278	
8	7-Chloroquinoline	31-2	267-8		250		253	
9	8-Iodoquinoline	36			200		251	
10	1,3,5-Trimethylpyrazole	37	170			147	187 91	n <sub>D</sub> <sup>20</sup> 1 4589
11	2-Chloroquinoline (α-Chloroquinoline)	38	267			122		
12	2,3-Dimethyl-5,6,7,8-tetrahydroquinoline	38	125 <sup>14</sup>		117	169		
13	7-Methylquinoline	39	252			237	223-4	
14	4-Bromoisquinoline	40	280 5		233			
15	6-Chloroquinoline	41	262	143	248			Ethiodide, 168 9
16	4-(Diethylamino)benzaldehyde	41, yel						Oxime, 93, Semicarbazone, 214 Phenylhydrazone, 103, Anil, 108-9 Hydrochloride, 154
17	3-Nitropyridine	41	216				254	
18	2,4,8-Trimethylquinoline	42	270		229	193		
19	4-Chloro-2-methylquinoline (4-Chloroquinaldine)	42 3			212	178		
20	5-Chloroquinoline	45	256		231, 172		255	
21	2,6,8-Trimethylquinoline	46	264 5			187-9	206-7	Hydrochloride, 207
22	2-(Dimethylamino)naphthalene (N,N-Dimethyl-β-naphthylamine)	47	305			206		
23	2,4,5,8-Tetramethylquinoline	48, pa yel	168-72 <sup>12</sup>			161		Hydrochloride, 254
24	5-Bromoquinoline	48, 52	280		205			Hydrochloride, 225
25	2-Bromoquinoline (α-Bromoquinoline)	49			210			
26	8-Methoxyquinoline	50	283		160	143		
27	7-Bromoquinoline	52, 34	290		240, yel			Hydrochloride, 213
28	2-Iodoquinoline (α-Iodoquinoline)	52-3			211-2			Ethiodide, 220
29	3-Iodopyridine (β-Iodopyridine)	53, 50					211	Chl nice cold CHCl <sub>3</sub> → chloride, 128 30, yel
30	4,8-Dimethylquinoline	54 5	258 9			216 7	226	
31	2,3,8-Trimethylquinoline	55-6	281			242 5		Hydrochloride, 260
32	2,6-Dimethylquinoline	60	266	175	236-7	186, 178		Styphnate, 200
33	N,N-Dimethyl-3-nitroaniline	60, red			205	119		
34	3,4'-Bipyridyl	62	297			215		
35	2,4,6-Trimethylquinoline	65 5 (anh), 39 5 (hyd)	281 2		245-7, 225	200-1		Hydrochloride, 268-72
36	3,3'-Bipyridyl (β,β-Bipyridyl)	68	291-2			232		
37	2,3-Dimethylquinoline	68 9	263		218	230 1	230	
38	2,2'-Bipyridyl (α,α'-Bipyridyl)	69				158		
39	5-Nitroquinoline	72 (anh)			215			Hydrochloride, 214
40	N,N-Dibenzylaniline	72, 70			135	131		
41	2,2'-Bis-(dimethylamino)-biphenyl	72-3			190-2			Hydroiodide, 256-7
42	3,4-Dimethylquinoline	73-4, 65	293		191	215, 205		Hydrochloride, 290
43	8-Hydroxy-2-methylquinoline (8-Hydroxyquinaldine)	74	266					Me eth, 125, b p 282
44	4-Dimethylaminobenzaldehyde	74						Semicarbazone, 222, <i>p</i> -Nitrophenylhydrazone, 182, 2,4-Dinitrophenylhydrazone, 325, Anil, 100, grn -yel
45	8-Hydroxyquinoline	75			143	204		Benzoate, 120, 1,3,5-Trinitrobenzene add comp, 124
46	N,N-Dimethyl-4-aminophenol (N,N-Dimethyl-4-hydroxyaniline)	76						Acetate, 78, Me eth, 49, <i>p</i> -Toluenesulfonyl, 130
47	8-Bromoisquinoline	80 5			274			Nitrate, 193

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**2. Tertiary amines b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Methyl <i>p</i> -toluene sulfonate	Methiodide	Picrate	Chloroplatinate	Miscellaneous
48	3,4'-Biquinolyl	83-4				244		Diethiodide, 198
49	2,2'-Dipyridylamine	84, 95 after resolrdification	307-8			227-8	160	
50	N,N-Dimethyl-4-nitrosoaniline (4-Nitroso-N,N-dimethylaniline)	85				140		Hydrochloride, 177
51	N,N-Dimethyl-3-aminophenol (N,N-Dimethyl-3-hydroxyaniline)	85						Benzoate, 95, Me urethane, 87
52	2,3,6-Trimethylquinoline	86-7	285			212		
53	6,6'-Dimethyl-2,2'-bipyridyl	89-90				170 1		HgCl <sub>2</sub> add comp, 238
54	4,4'-Bis-(dimethylamino)-diphenylmethane	91	390		214 (di)	185 (mono), 178 (di)		1,3,5-Trinitrobenzene add comp, 114, vlt
55	6-Iodoquinoline	91			> 300		265	Hydrochloride, 210
56	Tribenzylamine	91			184	190		Ethiodide, 190, β-Resorcyclic acid salt, 141
57	2,3,4-Trimethylquinoline	92	285		260	216	215	Hydrochloride, 274
58	4-Dimethylaminobenzophenone	92			188-90			Anil, 151, Phenylhydrazone, 105
59	N-Methyl-4-pyridone	92-4 hyg					176 (anh)	HgCl <sub>2</sub> double salt, 177-80
60	1,5-Dimethylbenzimidazole	95	300			255		Hydrochloride, 215
61	1-Phenylisoquinoline	95-6	300			165	242	Hydrochloride, 235
62	6-Bromo-2-methylquinoline (6-Bromoquinaldine)	96 7			237			Ethiodide, 218
63	4-Iodoquinoline (γ-Iodoquinoline)	97			251		185	
64	4,4'-Bis-(dimethylamino)-benzhydrol	98, 102, grn			195 (di)			Me eth, 71 2, 1,3,5-Trinitrobenzene add comp, 76
65	5-Iodoquinoline	100			245		263	
66	4,4'-Bis-(dimethylamino)-triphenylmethane (Leuco-malachite green)	102, bz, 93, al			231 (220) (di)			1,3,5-Trinitrobenzene add comp, 89
67	2,2'-Biquinolylmethane	103			205	239, 210 (di)		
68	2-Hydroxypyridine (α-Hydroxypyridine, α-Pyridone)	106-7	280-1					Benzoate, 42, HgCl <sub>2</sub> comp with Me eth, 200, HgCl <sub>2</sub> comp with Et eth, 141-2
69	Acridine	111			224	208		
70	3,5-Dibromopyridine	112	222	219	274			
71	1,2-Dimethylbenzimidazole	112 (anh), 65(hyd)	290		254	238		
72	Antipyrine (2,3-Dimethyl-1-phenyl-5-pyrazolone)	113	319			188		Salicylate, 92
73	4,4'-Bipyridyl	114 (anh), 73 (hyd)				257		Nitrate, 256
74	4-Dimethylaminoazobenzene	117, yel			174, al			Methochloride, 194
75	Triphenylamine	127	365					Hydrochloride, 214, Fuming HNO <sub>3</sub> in ac a → trinitro deriv, 280
76	3-Hydroxypyridine (β-Hydroxypyridine)	129						Oxalate, 177, Chloroplatinate of Et eth, 192
77	Methyleneaminoacetonitrile	129	210			127		Acid hydrolysis → glycine
78	7-Nitroquinoline	132 3			231-2			Ethiodide, 220
79	6,8'-Biquinolyl	148			126 (mono)	268		
80	4-Hydroxypyridine (γ-Hydroxypyridine)	149 (anh)						Acetate, 140 50, Benzoate, 81, Zn → pyridine, b p 116
81	6-Nitroquinoline	154, 149			245			Styphnate, 190, Hydrobromide, 245
82	Quinuclidine	158 (sealed tube)				275-6	238-40	Ethiodide, 270-1
83	2,7'-Biquinolyl	160			263	240		

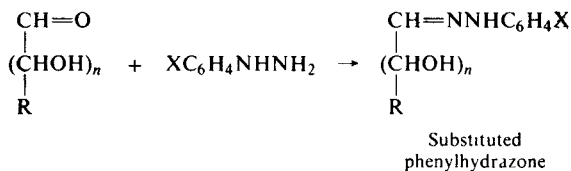
\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES  
2. Tertiary amines b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Methyl <i>p</i> -toluene sulfonate	Methiodide	Picrate	Chloroplatinate	Miscellaneous
84	2,2'-Biquinolyl ketone	164				179		Oxime, 201, Phenylhydrazone, 199
85	6-Hydroxypyrimidine	164-5				190		Acetyl, 180, 215-20 after re-solidification
86	7,7'-Biquinolyl	171-2			310 ( <i>mono</i> )	300		
87	4,4'-Bis-(dimethylamino) benzophenone (Michler's ketone)	174			105	156		Oxime, 233
88	5,5'-Biquinolyl	175			272	>300		Hydrochloride, 292
89	2,3'-Biquinolyl	176			286		278	
90	6,6'-Biquinolyl	181			>290 ( <i>di</i> )			Diethiodide, 270
91	6-Hydroxyquinoline	193				236		1,3,5-Trinitrobenzene add comp., 193-5
92	2,2'-Biquinolyl ( $\alpha, \alpha'$ -Biquinolyl)	196				210, 215		
93	3-Hydroxyquinoline ( $\beta$ -Hydroxyquinoline)	198				240-5		
94	1,2-Di(2-pyrrolyl)ethanedione (2,2'-Bipyrryl)	200, pa yel						<i>o</i> -Phenylenediamine $\rightarrow$ di-pyrrolylquinoxaline, 158, Monoxime, 147, Diphenylhydrazone, 146
95	4-Hydroxyquinoline ( $\gamma$ -Hydroxyquinoline)	201 (anh)						Hydrochloride, 187 (anh), KMnO <sub>4</sub> $\rightarrow$ kynuric acid, 200 (anh)
96	6-Hydroxy-2-methylquinoline (6-Hydroxyquinaldine)	213						Et eth, 71, Picrate of Et eth, 192, Ethiodide of Et eth, 182
97	5-Hydroxyquinoline	224			224		230	Hydrochloride, 240
98	4-Hydroxy-2-methylquinoline (4-Hydroxyquinaldine)	232 (anh)			201 (anh)	200	215	Me eth, 82
99	7-Hydroxyquinoline	235			251	244-5		Benzoate, 88-9
100	5-Hydroxy-2-methylquinoline (5-Hydroxyquinaldine)	246, 232-4						Picrate of Me eth, 217, Picrate of Et eth, 213, 206
101	4,4'-Dipyridylamine	273-5				235, 174	>280	Hydrochloride, > 300
102	Hexamethylene tetramine	280		205	190	179		Dil acid $\rightarrow$ formaldehyde, semicarbazone, 169

\*Derivative data given in order m p, crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE XIX

*Substituted phenylhydrazones \**

From the carbohydrate and one equivalent of phenylhydrazine in aqueous acetic acid

*For directions and examples see* Cheronis, p 520, Wild, p 77

From the carbohydrate, phenylhydrazine hydrochloride and sodium acetate in water

*See* Wild, p 77

From the carbohydrate with *p*-nitrophenylhydrazine hydrochloride and sodium acetate in methanol

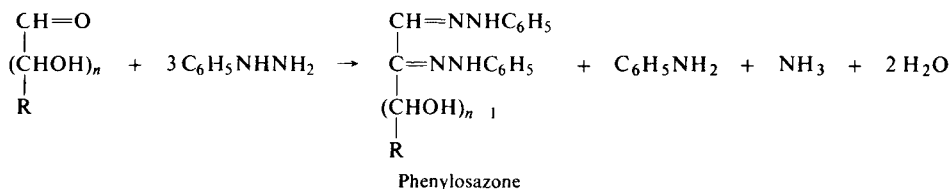
*See* Cheronis, p 523

From the carbohydrate and *p*-nitrophenylhydrazine in alcohol

*See* Vogel, p 456

From the carbohydrate and benzylphenylhydrazine in aqueous alcohol

*See* Shriner, p 77

*Phenylosazone \**

From the carbohydrate and excess of phenylhydrazine in glacial acetic acid

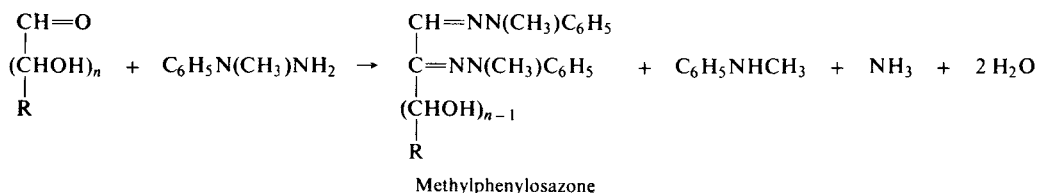
*For directions and examples see* Cheronis, pp 523, 524

From the carbohydrate, excess of phenylhydrazine hydrochloride and sodium acetate in aqueous acetic acid

*See* Cheronis, pp 524, 525 Linstead p 38 Shriner, p 132 Vogel, p 455

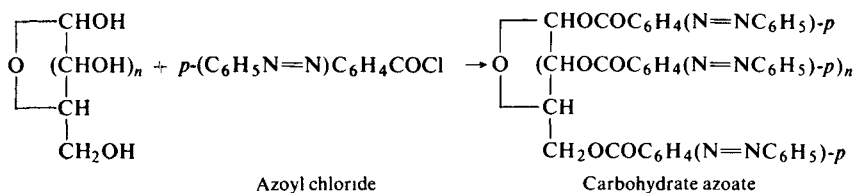
From the carbohydrate and excess of phenylhydrazine in methyl cellosolve-glacial acetic acid mixture

*See* W T Haskins, R M Hann and C S Hudson, *J Amer Chem Soc*, **68**, 1766 (1946)

*Methylphenylosazone*

From the carbohydrate and *as*-methylphenylhydrazine in aqueous alcohol

*For directions and examples see* Vogel, p 456

*p*-Phenylazobenzoate (azoate) \*

From the carbohydrate and azoyl chloride (*p*-phenylazobenzoyl chloride) in anhydrous pyridine

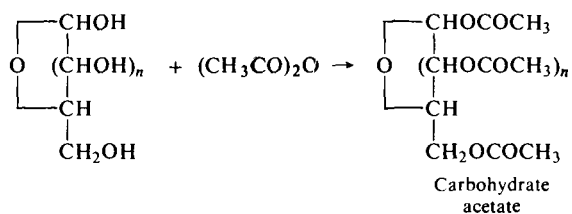
*For directions and examples see* Cheronis, p 526, G H Coleman, A G Farnham and A Miller, *J Amer Chem Soc*, **64**, 1501 (1942), G H Coleman and C M McClosky, *J Amer Chem Soc*, **65**, 1588 (1943)

**\*Derivatives recommended for first trial**

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLE XIX (Continued)

### Acetate



From the carbohydrate, acetic anhydride and sodium acetate

*For directions and examples see* Linstead, p 39, Shriner, p 212, Vogel, p 451, Wild, p 78

### *Specific rotation*

Specific rotation can be used as means for identification

*For directions and examples see* Cheronis, p 578, Wild, p 78

### *General references*

C A Browne and F W Zerban, *Physical and Chemical Methods of Sugar Analysis*, 3rd edition, John Wiley and Sons, New York, 1941, J Stanek, M Carny, J Kocourek and J Pacak, *The Monosaccharides*, Academic Press, New York, 1963, pp 865 955, G R Pigman in *The Carbohydrates*, (Ed W Pigman), Academic Press, New York, 1957, pp 602 640

\*Derivatives recommended for first trial

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives

**TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES**  
**a) Liquids (Listed in order of increasing m.p. of the corresponding phenylosazone derivatives)\***

No	Name	Melting point, °C	Specific rotation			RF-Values in <i>n</i> -butanol-acetic acid-water (4:1:5)	Phenylosazone		Azoate ( <i>p</i> -Phenylazobenzoate)		<i>p</i> -Nitrophenylhydrazone	<i>p</i> -Bromophenylhydrazone	Miscellaneous
			$[\alpha]_D$	T, °C	Conc., Solvent		M P	$[\alpha]_D^T$ Solvent	M P	$[\alpha]_{589}^{25}$ chl			
1	DL-Methyltetrose						140-2						Phenylbenzylhydrazone, 99 100
2	Apiose		+3 8,	20	c = 3 4,		156						<i>p</i> -Bromophenylosazone, 210 2
3	DL-Gulose		+5 6	15	water		157 9						Phenylhydrazone, 143, <i>p</i> -Bromophenylosazone, 183
4	L-Erythrose		+11 5 → +15 2 → +30 5	24	c = 3, water		164						Benzylphenylhydrazone, 105, $[\alpha]_D^{20}$ +32 8, c = 5, 95% al, Triacetyl, 134
5	D-Erythrose		-14 5	20	c = 11, water		164, 166	0 5, pyr - al					Benzylphenylhydrazone, 105 6 $[\alpha]_D^{20}$ +32 8, c = 5, 95% al, <i>p</i> -Bromophenylosazone, 195 Phenylhydrazone, 116
6	DL-Erythrose						164, 166 8						Benzylphenylhydrazone, 83
7	DL-Erythrulose						164						Methylphenylosazone, 158 9
8	L-Erythrulose		+12	20	water		164						<i>p</i> -Bromophenylosazone, 195
9	L-Idose		+52 7	20	c = 6 2, water		168, 160						
10	D-Gulose		-20 4 → +61 6	20	water		168, 160	+6, c = 0 4, me al					Phenylhydrazone, 143 <i>p</i> -Bromophenylosazone, 186
11	$\beta$ -Methylglycer-aldehyde						171						Benzylphenylhydrazone, 116
12	L-Methyltetrose		-30 5 → -16 5	20	c = 9 47, 96% al		172-3						Benzylphenylhydrazone, 96 7 Diethyl mercaptal, 109
13	D-Rhamnose (6-Desoxy-D-mannose)		-8 25	16 5	c = 10, water		185, 191	-95 2, pyr					<i>p</i> -Bromophenylosazone, 225, 222-3
14	3-Amino-3-desoxy-D-glucose		-61 → -78	18	water		207						N-Benzoyl, 128 30
15	DL-Xylulose (DL-Xyloketose)						210 5						Methylphenylosazone, 173

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES

b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point, °C	Specific rotation			Rf-Values in $\beta$ -butanol-acetic acid-water (4:1:5)	Phenylosazone		Azoate ( <i>p</i> -Phenylazobenzoate)		<i>p</i> -Nitrophenylhydrazone	<i>p</i> -Bromophenylhydrazone	Miscellaneous
			$[\alpha]_D$	T, °C	Conc, Solvent		M P	$[\alpha]_D^T$ Solvent	M P	$[\alpha]_{435}^{25}$ , chl			
1	1,3-Dihydroxyacetone	65-71 (monomer), 80 (dimer)					132				156, 160		Phenylhydrazone, 115, Me phenylosazone, 127 130 Diacetate, 46 7 Dibenzoate, 120, D1- <i>p</i> -nitrobenzoate, 198, Oxime, 84
2	$\beta$ -Melibiose dihydrate (6- $[\alpha$ -D-Galactosido]-D-glucose)	82-5	+111.7 $\rightarrow$ +129.5	20	c = 4, water		176-8	+43.2, pyr	280	+172			<i>p</i> -Bromophenylhydrazone, 181 2, Phenylhydrazone, 145 160 Oxime, 186, Octaacetate, 177 5, $[\alpha]_D^{20} + 102.5$
3	D-Ribose	87, 95	-21.5, -23.7	20	c = 4, water	0.31	164 160					170, ( $[\alpha]_D^{20} - 5.7$ , al)	<i>p</i> -Bromophenylhydrazone, 180 5, $\beta$ -Me glucoside, 83 4, $[\alpha]_D^{20} - 113.6$
4	L-Ribose	87	+20.3 $\rightarrow$ +20.7	20	c = 4, water		166					164 5	Phenylhydrazone, 154 5
5	2-Desoxy-D-ribose	90	+2.88 $\rightarrow$ +2.13	23	water								Benzylphenylhydrazone, 127 9
6	Glycollic aldehyde (Glycolaldehyde)	95 7					179						<i>p</i> -Nitrophenylosazone, 311, Diphenylosazone, 207, Benzylphenylosazone, 198, Monoacetate, 157 8, Phenylhydrazone, 162
7	D-Fructose	102 4	-132.2 $\rightarrow$ -92.4	20	c = 4, water	0.23	210		125	-440	176, ( $[\alpha]_D + 16$ , pyr -al)		<i>o</i> -Nitrophenylhydrazone, 156 7 $\alpha$ -Me phenylosazone, 161 2, Pentaacetate $\alpha$ -form, 70, $[\alpha]_D^{20} + 34.7$ , chl $\beta$ -form, 108-9, $[\alpha]_D^{20} - 120.5$ , chl
8	Lactic aldehyde (Lactaldehyde)	105					154, 145						Phenylhydrazone, 93
9	$\alpha$ -L-Rhamnose (6-Desoxy-L-mannose)	105, 93-4 (hyd)	-8.6 $\rightarrow$ +8.2	20	c = 4, water	0.37	222, 182	+94, pyr			186 191		<i>p</i> -Nitrophenylosazone, 208, 2-Naphthylhydrazone, 170, $[\alpha]_D + 8.4$ , me al, Semicarbazone, 183, $[\alpha]_D^{20} + 75 \rightarrow +57$ , w
10	L-Altrose	105, 107-9	-32.3	20	water		165 178						Benzylphenylhydrazone, 148
11	D-Altrose	105	+32.6	20	c = 7.6, water		178						Benzylphenylhydrazone, 148-50
12	2-Amino-2-desoxy-D-glucose (Glucosamine)	105-10	+48, +44		water		210						Phenylurea, 210, N-Acetyl, 190, Oxime, 127, Semicarbazone, 165
13	$\alpha$ -D-Lyxose	106-7, 101	+5.5 $\rightarrow$ -14.0		c = 8, water		164				172	162, 156 7	Benzylphenylhydrazone, 116, 128, $[\alpha]_D^{20} + 26.4$ , c = 4 9, abs al

\* Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Specific rotation			Rf Values in <i>n</i> -butanol-acetic acid-water (4:1:5)	Phenylosazone		Azoate ( <i>p</i> -Phenyl azobenzoate)		<i>p</i> Nitro phenylhydrazone	<i>p</i> -Bromo phenylhydrazone	Miscellaneous
			$[\alpha]_D$	T °C	Conc Solvent		M P	$[\alpha]_D^T$ Solvent	M P	$[\alpha]_{25}^{25}$ chl			
14	Raffinose (2-[6-( $\alpha$ -D Galactosido)- $\alpha$ -D-glucoside] $\beta$ -D-fructose)	118.9, (anh) 80 (hyd)	+123, +105.2	20	water c = 4, water	0.05			145	+146			Trityl, 130, $\alpha$ -Methylphenylhydrazone, 190, Emulsin $\rightarrow$ sucrose + galactose
15	$\beta$ -L-Rhamnose	122.6	+9.1	20	water		222, 185	+94 pyr			190.1, ( $[\alpha]_D^{20}$ +21.4)		$\alpha$ -Methylphenylhydrazone, 124, <i>p</i> -Bromophenylosazone, 222
16	D-Tagatose	124	+1.0	22	c = 1, water		196.7, 201						Diacetone deriv, 65.6, ( $[\alpha]_D^{20}$ +71.8), w
17	D-Threose	126.32	+29 $\rightarrow$ +19.6	22	water		164						Benzylphenylhydrazone, 194, bz, Acetone deriv, 84, Triacetate, 113.4, ( $[\alpha]_D^{20}$ +35.5), chl
18	D-1-Amino-fructose	127.8					210						
19	$\beta$ -D-Allose	128	+0.58 $\rightarrow$ +14.41	20	c = 5, water		178, 174				145, ( $[\alpha]_D^{20}$ -6.7, al)		
20	$\beta$ -L-Allose	128.9	-1.9	20	water		165				141.5, ( $[\alpha]_D^{20}$ +6.4, al)		
21	D-Talose	128.30	+30 $\rightarrow$ +20.6	21	water		201, 197					205	Phenylhydrazone, 178, Benzylphenylhydrazone, 199
22	DL-Xylose	129.31					210.5						
23	$\alpha$ -D-Mannose	133	+29.3 $\rightarrow$ +14.2	20	c = 4, water	0.20	210				194.5, ( $[\alpha]_D^{20}$ +56, pyr-al (1.1))	208.10	Phenylhydrazone, 199, 200, ( $[\alpha]_D^{20}$ +26.3 $\rightarrow$ +33.8, pyr, $\alpha$ -Methylphenylhydrazone, 178, ( $[\alpha]_D$ +8.6, c = 0.5, me al, Benzylphenylhydrazone, 165
24	$\beta$ -D-Mannose	132	-17.0 $\rightarrow$ +14.2	20	c = 4, water		210				194.5	208.10	Phenylhydrazone, 199, 200, $\alpha$ -Methylphenylhydrazone, 178, CaCl <sub>2</sub> add comp, 101.2
25	L-Mannose	132	+14.0 $\rightarrow$ -14.0		water		208						Phenylhydrazone, 195, ( $[\alpha]_D$ +1.2, HCl
26	DL-Mannose	132.3					217.9						Phenylhydrazone, 195
27	$\alpha$ -D-Mannoheptose	134.5	+85.05 $\rightarrow$ +68.64	20	c = 11, water		200					207-8	Phenylhydrazone, 197, Hexaacetate, 106, 50% al, 139.40, eth
28	DL-Glyceraldehyde (dimer)	139, 142					132						<i>p</i> -Bromophenylosazone, 168, Dibenzozate, 231, Di- <i>p</i> -nitrobenzoate, 247, Semicarbazone, 160, 2,4-Dinitrophenylhydrazone, 166-7
29	D-Isorhamnose (6-Desoxy-D-glucose)	139-40	+72.3 $\rightarrow$ 29.7	20	c = 10, water		185, 187.9						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized



TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Specific rotation			Rf-Values in <i>n</i> -butanol-acetic acid water (4:1:5)	Phenylosazone		Azoate ( <i>p</i> -Phenylazobenzate)		<i>p</i> -Nitrophenylhydrazone	<i>p</i> Bromophenylhydrazone	Miscellaneous
			[α] <sub>D</sub>	T, °C	Conc. Solvent		M P	[α] <sub>D</sub> <sup>T</sup> Solvent	M P	[α] <sub>D</sub> <sup>25</sup> chl			
30	α-L-Glucose	141.3	-95.5 → -51.4	20	c = 4, water		208						Diphenylhydrazone, 162
31	L-Xylose	144, 141.3	-79.3 → -18.6	20	c = 9.94, water		159.61						Tetraacetate, 126 (β-form)
32	α-D-Xylose	145, 143	+93.6 → +18.8	20	c = 4, water	0.28	164 155	-40.9, al	157	+244	155	128	Me phenylhydrazone, 108. Benzylphenylhydrazone, 95, [α] <sub>D</sub> -33, c = 0.57, al 2-Naphthylhydrazone, 124, [α] <sub>D</sub> +18.6, me al Methylphenylosazone, 181, Oxime, 188.9, [α] <sub>D</sub> +13.2, w
33	D-Fucose (6-Desoxy-D-galactose, D-Rhodoose)	145	+89.3 → +75.7	22	water		177						
34	L-Fucose (6-Desoxy-L-galactose, L-Rhodoose)	145	-152.6 → -75.9	20	c = 4 water	0.27	178				210.1	181.4	Phenylhydrazone, 170, α-Methylphenylhydrazone, 174, [α] <sub>D</sub> <sup>17</sup> -17.0, pyr Oxime, 188.9, α-Me glucoside, 158, [α] <sub>D</sub> <sup>19</sup> -197.5, w β-Me glucoside, 119, [α] <sub>D</sub> <sup>19</sup> +16.04, w
35	α-D-Glucose	146 (anh), 83 (hyd)	+112.2 → +52.7	20	c = 4, water	0.18	210	-1.5, c = 2, pyr-al (1.1)	266	+223	88, 196 ([α] <sub>D</sub> +21.5, me al)	164.6, ([α] <sub>D</sub> -43.6 +18.9 c = 4, pyr)	2-Naphthylhydrazone, 178 <i>p</i> -Nitrophenylosazone, 257, 2,4-Dinitrophenylosazone, 256.7, α-Pentaacetate, 112
36	2-Desoxy-D-glucose	148	+46.6	18	water								Benzylphenylhydrazone, 158.9
37	β-D-Glucose	148.50	+18.7 → +52.7	20	c = 4, water		210						<i>p</i> -Nitrophenylosazone, 257, 2,4-Dinitrophenylosazone, 256.7 β-Pentaacetate, 132
38	Melezitose (2-[3-(α-D-Glucosido)-D-fructosido]-α-D-glucose)	153-4 (+2 H <sub>2</sub> O)	+88.2	20	c = 4, water				130 (sin- teres)	+188			
39	Turanose (3-[α-D-Glucosido]-D-fructose)	157 (anh), 60.5 (hyd)	+27.3 → +75.8	20	c = 4, water		215.20						Heptaacetate, 140.1, eth, [α] <sub>D</sub> <sup>19</sup> +37, chl
40	β-D-Arabinose	158-9	-175 → -105		c = 9.45, water	0.21	162.3, 160						Oxime, 136, Benzylphenylhydrazone, 173
41	β-L-Arabinose	160	+190.6 → +104.5	20	water		166		262	+755	186	155	Benzylphenylhydrazone, 174, Me phenylhydrazone, 165, Oxime, 139, Tetraacetate, α-form 94.6, eth, β-form 86, w, Tetrabenzate, 160.1, 173, Semicarbazone, 190, 163

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Specific rotation			Rf Values in <i>n</i> -butanol-acetic acid-water (4:1:5)	Phenylosazone		Azoate ( <i>p</i> -Phenylazobenzoate)		<i>p</i> -Nitrophenylhydrazone	<i>p</i> -Bromophenylhydrazone	Miscellaneous
			$[\alpha]_D$	T, °C	Conc., Solvent		M P	$[\alpha]_D^T$ Solvent	M P	$[\alpha]_{589}^{25}$ , chl			
42	$\beta$ -D-Galacturonic acid	160	(+55.3)	20	water							151 ( $[\alpha]_D + 11.5$ , me al)	Phenylhydrazone, 140, Brucine salt, 180
43	$\beta$ -Maltose (4- $[\alpha$ -D-Glucosido]- $\beta$ -D-glucose)	160.5, 102.3 (+1 H <sub>2</sub> O)	+111.7 → +130.4	20	c = 4, water	0.11	205-6		275	+2			Phenylhydrazone, 130, <i>p</i> -Nitrophenylosazone, 261, <i>p</i> -Bromophenylosazone, 198, 2-Naphthylhydrazone, 176, Octaacetate, 160.1, $[\alpha]_D^{60} + 62.59$ , chl Diacetone deriv., 41
44	DL-Fucose (6-Desoxy-DL-galactose, DL-Rhodoese)	161					187						
45	DL-Sorbose	162.3				0.20	169.70						
46	L-Galactose	162-3	-120 → -73.6 →		c = 10, water		192.5						Phenylhydrazone, 158.60, $[\alpha]_D + 21.6$ , w
47	DL-Galactose	163, 144					206						Phenylhydrazone, 158.60, $\alpha$ -Methylphenylhydrazone, 183
48	$\beta$ -D-Glucuronic acid	163	+36.3	20	water						225		Semicarbazone, 188, Cinchonine salt, 204, $[\alpha]_D^{60} + 139.9$ , w
49	DL-Arabinose	164					169					160	Diphenylhydrazone, 204, <i>p</i> -Bromophenylosazone, 200-2
50	L-Sorbose	165, 159.61	-43.7 → -43.4	20	c = 12, water	0.20	156, 168						<i>p</i> -Bromophenylosazone, 181 <i>o</i> -Nitrophenylosazone, 211 2, $\beta$ -Me glucoside, 120-2, $[\alpha]_D^{60} - 88.5$ , w, Pentaacetate, 97, $[\alpha]_D + 2.9$ , chl $\beta$ -Me glucoside, 119, $[\alpha]_D + 88.5$ , w Benzylphenylhydrazone, 223-5
51	D-Sorbose	165	+42.9	20	c = 1, water		168, 160						
52	3-( $\beta$ -D-Galactosido)-D-arabinose	166-8	-50.3 → +63.1	19	water		242						
53	$\alpha$ -D-Galactose	167	+150.7 → +80.2	20	c = 5, water	0.16	196, 201		276	+436	154, 197	168	$\alpha$ -Methylphenylhydrazone, 190-1, Benzylphenylhydrazone, 157, Diphenylhydrazone, 157, $\alpha$ -Pentaacetate, 95 Tetradecaacetate, 95-6, $[\alpha]_D^{60} + 120$ , al, Tetradeca- <i>p</i> -nitrobenzoate, 166
54	Stachyose ( $\alpha$ -Galactosyl $\frac{1 \rightarrow 6'$ $\alpha$ -galactosyl $\frac{1' \rightarrow 4$ $\alpha$ -glucosyl $\frac{1 \rightarrow 2'$ $\beta$ -fructoside)	167-70	+148	20	water								
55	Sucrose (2- $[\alpha$ -D-Glucosido]- $\beta$ -D-fructose)	169.70, me al, 185, w - al	+66.53	20	c = 26, water	0.14			125	+35			Nonreducing, Octaacetate, 72, 69, $[\alpha]_D^{60} + 59.6$ , chl, Tritrityl, 128

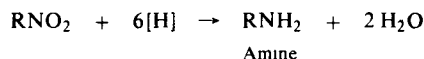
\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Specific rotation			Rf Values in <i>n</i> -butanol-acetic acid-water (4:1:5)	Phenylosazone		Azoate ( <i>p</i> -Phenylazobenzoate)		<i>p</i> -Nitrophenylhydrazone	<i>p</i> -Bromophenylhydrazone	Miscellaneous
			$[\alpha]_D$	T, °C	Conc., Solvent		M P	$[\alpha]_D^T$ Solvent	M P	$[\alpha]_{589}^{25}$ , chl			
56	D-Glucoheptulose	171	+67.4	20	water		209-10						Hexaacetate, 112, $[\alpha]_D^{20} + 87.0$ , $\alpha$ -Me glucoside, 138.40, $[\alpha]_D^{25} + 108.5$ w
57	4- $\beta$ -D-Glucosido- $\beta$ -D-mannose	176 (anh), 139.40 (hyd)	+15.1 $\rightarrow$ +10.7	16	water		198						
58	$\alpha$ -L-Rhamnohexose	180.1	-80 $\rightarrow$ -61.4	20	c = 9.67, water		200						Benzylphenylhydrazone, 183.4
59	L-Ascorbic acid	190, 187	+49	18	me al	0.38					262 (dl)	170 (dl)	Diphenylhydrazone, 187. Di-2,4 dinitrophenylhydrazone, 282
60	Gentiobiose (6- $[\beta$ -D-Glucosido] D-glucose)	190-5 (anh), 86 (hyd)	+21.4 $\rightarrow$ +8.7	20	c = 5, water		163.4, 170, 179	-42.9 <sup>20</sup> , 95° al					Octaacetate ( $\alpha$ ) 188.9, $[\alpha]_D^{20} + 52.3$ , chl, ( $\beta$ ) 192.3, $[\alpha]_D^{20} - 5.3$ , chl
61	$\alpha$ -D-Glucoheptose	193	-20	20	water		194-5						$\beta$ -Me glucoheptoside, 169, $[\alpha]_D - 75$ , w, Hexaacetate, 164 ( $\alpha$ form), 135 ( $\beta$ -form)
62	$\alpha, \alpha$ -Trehalose (1- $[\alpha$ -D-Glucosido]- $\alpha$ -D-glucose)	210, 203 (anh), 97 (+2 H <sub>2</sub> O)	+178.3	20	c = 7, water				134.5	+210			Nonreducing Octamtrate, 124. Octaacetate, 100.2, $[\alpha]_D^{20} + 162$ , chl. Hexaacetate, 93-6, $[\alpha]_D^{19} + 158.3$ , chl
63	Primeverose (6- $[\beta$ -D-Xylosido]-D-glucose)	210, 208	+24.1 $\rightarrow$ -3.3		c = 2.5, water		220						$\beta$ -Heptaacetate, 216, $[\alpha]_D^{20} - 23.5$ , chl
64	Lactose (4- $[\beta$ -D-Galactosido]-D-glucose)	$\alpha$ -form, 223 (anh), 201 (hyd), $\beta$ -form, 252 (anh)	+90 $\rightarrow$ +55.3 (+52.3) +35 $\rightarrow$ +55.3 (+52.3)	20 20	c = 4, water c = 4, water	0.09	200, 210-2						<i>p</i> -Nitrophenylosazone, 258, Octaacetate, 100. Benzylphenylhydrazone, 128, 2-Naphthylhydrazone, 203
65	$\beta$ -Cellobiose (4- $[\alpha$ -D-Glucosido]- $\beta$ -D-glucose)	225	+14.2 $\rightarrow$ +34.6	20	c = 8, water		208, 10, 198	-6.5 <sup>20</sup> , pyr-al (1:1)	273	+105			Phenylhydrazone, 90, Octaacetate, ( $\alpha$ ) 229.30, $[\alpha]_D^{20} + 42$ , chl, Semicarbazone, 183.5, Octaacetate ( $\beta$ ), 192, 202, $[\alpha]_D^{20} - 14.5$ , chl, Oxime, 123.5
66	6- $[\beta$ -Cellobiosido]- $\alpha$ -D-glucose	247-52 (anh), 200 (hyd)	+15.0 $\rightarrow$ +8.4		water		224						
67	6- $[\beta$ -Lactosido]- $\alpha$ -D-glucose	257	+34.7 $\rightarrow$ +22.6	24	water		233						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE XX

*Formation of amine by reduction \**

From the nitro compound and tin in hydrochloric acid

*For directions and examples see* Cheronis, p 625, Linstead, p 69, Shriner, p 262, Vogel, p 529, Wild, p 247

From catalytic hydrogenation (Raney nickel, platinum oxide and palladium on charcoal) of the nitro compound in ethanol, methanol or dioxane

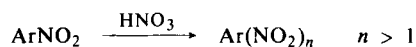
*See* Cheronis, p 626, Linstead, p 70, N D Cheronis and M Koeck, *J Chem Ed*, **20**, 488 (1943), K Johnson and E F Degering, *J Amer Chem Soc*, **61**, 3194 (1939), S V Voris and P E Spoerri, *J Amer Chem Soc*, **60**, 935 (1938), E R Blout and D C Silverman, *J Amer Chem Soc*, **66**, 1442 (1944)

From the nitro compound and lithium aluminum hydride in ethers

*See* N G Gaylord, *Reduction with Complex Metal Hydrides*, Interscience, New York, 1956, pp 762-773

For partial reduction of polynitro compounds with sodium or ammonium polysulfide *see* Linstead, p 71, Vogel, p 551

*NOTE* For directions and examples for the preparation of the derivatives of the amine formed on reduction of the nitro compounds see explanations and references to Table XVIII, p 291, 292, 293, 294

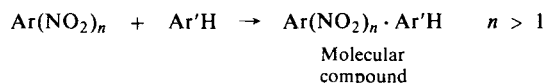
*Polynitro derivative \**

From the aromatic nitro compound with concentrated or fuming nitric acid and sulfuric acid

*For directions and examples see* Cheronis, pp 580, 627, Shriner, p 249, Vogel, pp 526, 527

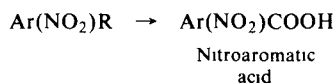
From fuming nitric acid in acetic acid or acetic anhydride

*See* Wild, pp 24, 247, 248, J Reilly and W J Hickinbottom, *J Chem Soc*, **117**, 135 (1920), O L Brady and W H Gibson, *J Chem Soc*, **119**, 102 (1921)

*Molecular compounds of aromatic polynitro compounds with aromatic hydrocarbons*

Molecular addition compounds are formed from the aromatic polynitro compound and aromatic hydrocarbons

*For directions and examples see* Table IV, p 32, 33, 34 Wild, p 248, T Asahina and C Shinomiya, *J Chem Soc Japan*, **59**, 341 (1938), O C Dermer and R B Smith, *J Amer Chem Soc*, **61**, 748 (1939)

*Nitroaromatic acids from side-chain oxidation*

From the alkylaromatic nitro compound and basic aqueous potassium permanganate

*For directions and examples see* Cheronis, p 627, Vogel, p 629

From the alkylaromatic nitro compound and sodium bichromate and sulfuric acid in water

*See* Cheronis, p 628, Vogel, p 629

\*Derivatives recommended for first trial

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives

TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS  
a) Liquids (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub>	Density g/ml	Data for the corresponding amine obtained on reduction of all nitro groups						Nitration product		Miscellaneous	
						Amine		Acet amide	Benz amide	Benzene sulfon amide	Picrate	Melting point, °C	Position of nitro groups		
						Boiling point, °C	Melting point, °C								
1	Nitroethylene	98.9			1.073 <sup>14</sup>	16.5			71	58	165			Polymerizes readily on contact with base	
2	Nitromethane	101	-17	1.3797 <sup>25</sup>	1.1297 <sup>25</sup>	-6		28	80	30	207 215				
3	Nitroethane	114		1.392 <sup>20</sup>	1.0497 <sup>20</sup>	16.5			71	58	165			Phenylthiourea deriv of amine, 101, 1-Naphthylurea deriv of amine, 200	
4	2-Nitropropane	120		1.394	1.024 <sup>9</sup>	33			26						
5	3-Nitropropylene (3 Nitropropene)	125.30			1.051 <sup>21</sup>	58				39	140				
6	1-Nitropropane	132		1.4002 <sup>24</sup>	1.008 <sup>24</sup>	49			84	36	135				
7	DL-2-Nitrobutane	140		1.4013	0.9877 <sup>9</sup>	63			76	70	139-40				
8	2-Methyl-1-nitropropane	140.1			0.987 <sup>7</sup>	69			57	53	150				<i>p</i> Toluenesulfonamide deriv of amine, 78
9	2-Methyl-2-nitrobutane	150				78					183				
10	DL-2-Nitropentane	152.4				92									Hydrochloride of amine, 168, Oxalate, 226-131 Chloroaurate, 82-3
11	1-Nitrobutane	153		1.4103 <sup>20</sup>	0.9710 <sup>20</sup>	77					151				
12	1-Nitroisobutylene (1-Nitroisobutene)	154-8			1.052 <sup>9</sup>	69			57	53	150				
13	3-Methyl-1-nitrobutane	164				96					138			Phenylthiourea deriv of amine, 102, 1-Naphthylurea deriv of amine, 132	
14	1-Nitropentane	173		1.4175	0.9525 <sup>20</sup>	104					139				
15	2-Nitrohexane	176			0.9357 <sup>20</sup>	116-8								Phenylthiourea deriv of amine, 75 Hydrochloride of amine, 133 Oxalate, 204-5, Chloroaurate, 63-4 SnCl <sub>2</sub> + HCl → Cyclohexanone oxime 89-90 1-Naphthylthiourea deriv of amine, 72	
16	1-Nitrohexane	193		1.4234	0.9396 <sup>20</sup>	130			40	96	126				
17	1-Nitroheptane	193.5			0.9476 <sup>17</sup>	155					121				
18	2-Nitroheptane	194.8			0.9466 <sup>9</sup>	142									
19	Nitrocyclohexane	205.6	-34	1.4612 <sup>19</sup>	1.068 <sup>19</sup>	134		104	147					SnCl <sub>2</sub> + HCl → Cyclohexanone oxime 89-90 1-Naphthylthiourea deriv of amine, 72	
20	1-Nitrooctane	206.10 part d			0.9346 <sup>20</sup>	180					112				
21	Nitrobenzene	210.1		1.553 <sup>20</sup>	1.2031 <sup>20</sup>	184		114	160	112	90	1,3			
22	2-Nitrotoluene	222		1.5474 <sup>20</sup>	1.1622 <sup>19</sup>	200		110-11	146, 143	124	213	70-1	2,4		

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS  
a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Data for the corresponding amine obtained on reduction of all nitro groups					Nitration product		Miscellaneous	
						Amine		Acetamide	Benzamide	Benzene sulfonamide	Picrate	Melting point, °C		Position of nitro groups
						Boiling point, °C	Melting point, °C							
23	1-Ethyl-2-nitrobenzene	224		1.5407 <sup>19</sup>	1.126 <sup>24</sup>	210-11		111-2	147		194-5			
24	1,3-Dimethyl-2-nitrobenzene (2-Nitro- <i>m</i> -xylene)	226	13		1.112 <sup>15</sup>	215-218		177	168		180	182	1,3,5	<i>p</i> -Toluenesulfonamide deriv of amine, 212
25	Phenylnitromethane	226d		1.5323 <sup>20</sup>	1.1598 <sup>20</sup>	184-5		60	105	88	194			
26	3-Nitrotoluene	233	16	1.5470 <sup>21</sup>	1.1571 <sup>20</sup>	203		65	125	95	200			Oxid → 3-nitrobenzoic acid, 140
27	1,4-Dimethyl-2-nitrobenzene (2-Nitro- <i>p</i> -xylene)	241-2			1.132 <sup>15</sup>	213-5		139	140	138	171	139	1,2,4	
28	1-Ethyl-4-nitrobenzene	241		1.5458 <sup>19</sup>	1.124 <sup>25</sup>	216-214		94	151			37	2,4,6	<i>p</i> -Toluenesulfonamide deriv of amine, 104
29	1,3-Dimethyl-4-nitrobenzene (4-Nitro- <i>m</i> -xylene)	246	2		1.126 <sup>17,5</sup>	217		133-130	192	129-30	209	182	1,3,5	
30	1,2-Dimethyl-3-nitrobenzene (3-Nitro- <i>o</i> -xylene)	250	15			221-2		135	189		221	82	1,2	
31	2-Nitro- <i>p</i> -cymene	264		1.5309 <sup>20</sup>	1.0744 <sup>20</sup>	241		71	102			54	2,6	
32	2-Nitroanisole	265	10	1.5620 <sup>20</sup>	1.2540 <sup>20</sup>	225	5-6	85-88	60-84	89	200	68	2,4,6	
33	1- <i>tert</i> -Butyl-4-nitrobenzene	267				230	17	169-70	134-6					Dil HNO <sub>3</sub> → 4-nitrobenzoic acid, 240
34	2-Nitrophenetole	268	5-6	1.5425 <sup>20</sup>	1.1903 <sup>15</sup>	229		79	104	102		86	2,4	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS**
**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point, °C	Data for the corresponding amine obtained on reduction of all nitro groups						Nitration product		Miscellaneous
				Amine		Acet-amide	Benz-amide	Benzene sulfon-amide	Picrate	Melting point °C	Position of nitro groups	
				Boiling point, °C	Melting point, °C							
1	2-Methyl-2-nitropropane ( <i>tert</i> -Nitrobutane)	25-6	127	46			134		198			Phenylthiourea deriv of amine, 120
2	4-Fluoro-1-nitrobenzene	25-7		184-6		152	185					N- <i>p</i> -Nitrobenzamide deriv of amine, 181
3	1-Nitro-2,3,6-trimethylbenzene	30		235		186						
4	3,4-Dimethyl-1-nitrobenzene (4-Nitro- <i>o</i> -xylene)	30		226	51, 47-8	99				82	1,2	N-Formyl deriv of amine, 52 N-Chloroacetyl, 109
5	2-Chloro-1-nitrobenzene	32		209		87	99	129	134	50-52	2,4	
6	2,4-Dichloro-1-nitrobenzene	33	258		63	143-6	115	128	106			N-Formyl deriv of amine, 154
7	4-Bromo-3-nitrotoluene	33		136 <sup>16</sup>		121, 114						
8	3-Nitrophenetole (3-Ethoxy-1-nitrobenzene)	34		248		97	103			158		<i>p</i> -Toluenesulfonamide deriv of amine, 157
9	2-Nitrobiphenyl	37, 33			49-50	121	102					N-Formyl deriv of amine, 75
10	6-Chloro-2-nitrotoluene	37	238		245	157-9	173					Oxid → 6-chloro-2-nitrobenzoic acid, 161
11	3-Iodo-1-nitrobenzene	38, 35			33, 27	119	157					<i>p</i> -Toluenesulfonamide deriv of amine, 128
12	3-Nitroanisole (3-Methoxy-1-nitrobenzene)	38	258	251		81			169	106	3,5	<i>p</i> -Toluenesulfonamide deriv of amine, 68
13	4-Chloro-2-nitrotoluene	38	240		21-2	139-40, 131						Oxid → 4-chloro-2-nitrobenzoic acid, 142
14	5-Nitroindane	40, yel	152 <sup>14</sup>	250	37-8	106	137					
15	2-Bromo-1-nitrobenzene	43		250	32	99	116		129	72	1,3	
16	4-Nitroindane	44	139 <sup>10</sup>	236	-3	126	136					
17	Nitromesitylene	44		232-3		216-7	204		189-91	86	<i>di</i>	<i>p</i> -Toluenesulfonamide deriv of amine, 167
18	3-Chloro-1-nitrobenzene	45		230		72, 78	119-20	121	177			
19	2-Nitroazoxybenzene	49, yel			98	156						
20	2-Iodo-1-nitrobenzene	49			61, 58	109	139		112			
21	4-Nitrotoluene	52	234	200	45	147	158	120	182	70	2,4	
22	4-Chloro-1,3-dinitrobenzene (1-Chloro-2,4-dinitrobenzene)	52			91	142 ( <i>di</i> )	178 ( <i>di</i> )			183	2,4,6	NaOH → 2,4-Dinitrophenol, 114, Hydrazine → 2,4-dinitrophenylhydrazine, 199
23	4-Nitroanisole (4-Methoxy-1-nitrobenzene)	53		240	58	130, 127	154	95		89	2,4	
24	2,5-Dichloro-1-nitrobenzene	54			50, 1gr	132	120			104	1,3	
25	4-Iodo-3-nitrotoluene	55			48, 38	151, 136						N-Formyl deriv of amine, 129, NaOH → 3-Nitro- <i>p</i> -cresol, 36-7
26	3-Bromo-1-nitrobenzene	56		251	18	87	120, 136		180	59	1,2	
27	1-Nitronaphthalene	57, 60			50	159	160	167	163, 181			
28	$\beta$ -Nitrostyrene	58, yel	250-60d									Irradiation → dimer, 180-7
29	1-Methyl-2-nitronaphthalene	58-9, yel			51	188-9	222					

\*Derivative data given in order m.p., crystal color, solvent from which crystallized.

TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Data for the corresponding amine obtained on reduction of all nitro groups						Nitration product		Miscellaneous
				Amine		Acetamide	Benzamide	Benzene sulfonamide	Picrate	Melting point, °C	Position of nitro groups	
				Boiling point, °C	Melting point, °C							
30	4-Nitrophenetole (1-Ethoxy-4-nitrobenzene)	60-58		248-254	3-4	137	173	143	69	86	2,4	
31	3,4-Dinitrotoluene	61		265	89-90	4 mono 131-2, di 210	3-mono 193-4 di 263-4	178-9 (di)				Oxid → 3,4-dinitrobenzoic acid, 165, 161
32	3-Nitrobiphenyl	61, 59			30	148						
33	2,3-Dinitrotoluene	63		255	63-4							(NH <sub>4</sub> ) <sub>2</sub> S → 2-Nitro- <i>m</i> -toluidine, 108, red HNO <sub>3</sub> → 2,3-Dinitrobenzoic acid, 201
34	1-Methyl-8-nitronaphthalene	63-4			67-8	183-4	195-6					
35	2,6-Dinitrotoluene	66			105	202-3				80, 82	2,4,6	Oxid → 2,6-Dinitrobenzoic acid, 202-3
36	2,4,6-Trinitroanisole (1-Methoxy-2,4,6-trinitrobenzene)	68										Naphthalene adduct, 69-70, NH <sub>3</sub> in al → picramide, 188
37	2,4-Dinitrotoluene	70, 72		292	99	224 (di)	224 (di)	2 mono 138 di 191		80, 82	2,4,6	Naphthalene adduct, 60, Oxid → 2,4-dinitrobenzoic acid 182-3 SnCl <sub>2</sub> + HCl → 4-Nitro- <i>o</i> -toluidine, 107 vel
38	2-Nitroazobenzene	71, or-red			59	126	122					
39	1-Methyl-4-nitronaphthalene	71-2, pa yel			51-2	166-7	238-9					Dil HNO <sub>3</sub> → 4-nitro-1-naphthoic acid, 220-1
40	4-Bromo-1,3-dinitrobenzene (1-Bromo-2,4-dinitrobenzene)	75, 72										NaOH → 2,4-Dinitrophenol, 114 Al NH <sub>3</sub> → 2,4-dinitroaniline, 180-188, yel Sn + HCl → 1,3-Diaminobenzene 63, Hydrazine → 2,4-dinitrophenylhydrazine, 199
41	3,5-Dimethyl-1-nitrobenzene	75	273	220-1		144, 140						N-Formyl deriv of amine, 76-7
42	4,5-Dimethyl-1,3-dinitrobenzene	76										(NH <sub>4</sub> ) <sub>2</sub> S → 1-Amino-3,4-dimethyl-5-nitrobenzene, 75 Acetyl deriv of this, 209-10, Benzoyl deriv of this, 223-4
43	5-Methyl-2-nitronaphthalene	76-7			63-4	123-4	155-6					
44	2-Nitronaphthalene	78			112	132	162	102	195			
45	2,4,6-Trinitrophenetole (1-Ethoxy-2,4,6-trinitrobenzene)	78										Naphthalene adduct, 39, NH <sub>3</sub> in al → picramide, 188
46	2,4,6-Trinitrotoluene (T N T)	80, 82										Naphthalene adduct, 97; CrO <sub>3</sub> /conc H <sub>2</sub> SO <sub>4</sub> → 2,4,6-trinitrobenzoic acid, 220
47	2-Methyl-1-nitronaphthalene	81, yel			32, pet eth	188	180					
48	4-Nitrophenanthrene	81			105	190	224					
49	3,4-Dimethyl-1,2-dinitrobenzene	82										Reduct → 1-amino-3,4-dimethyl-2-nitrobenzene, 66, red, Acetyl deriv of this, 115-6, Benzoyl deriv of this, 199-200

\* Derivative data given in order m.p., crystal color, solvent from which crystallized



TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Data for the corresponding amine obtained on reduction of all nitro groups						Nitration product		Miscellaneous
				Amine		Acet-amide	Benz-amide	Benzene sulfon-amide	Picrate	Melting point °C	Position of nitro groups	
				Boiling point, °C	Melting point, °C							
50	5-Methyl-1-nitro-naphthalene	82-3			77-8	194-5	173-4					
51	Picryl chloride	83				208 (tri)			211			NaOH → Picric acid, 122 NH <sub>3</sub> → 2,4,6-Trinitroaniline, 188-192-5 NaOH → 4-Nitrophenol, 114
52	4-Chloro-1-nitrobenzene	84			72	179-172	192	122				NaOH → 4-Nitrophenol, 114
53	2,5-Dibromo-1,4-dinitrobenzene	127										2,5-Dibromo- <i>p</i> -nitroaniline, 175, yel
54	2,4-Dimethyl-1,3-dinitrobenzene	84-82			65-6, lgr	>260 (di)	232 (227) (di)					Reduct → 1-amino-2,4-dimethyl-3-nitrobenzene 84 N,N-Diformyl, 219-20 Reduct → 2-amino-4-nitro-mesitylene, 75 Acetyl deriv of this, 191 Benzoyl deriv of this, 169 Benzenesulfonyl deriv of this, 163
55	2,4-Dinitromesitylene	85								232	2,4,6	
56	2,5-Dibromo-1-nitrobenzene	85			51-2	171-2						
57	4-Bromo-1-nitro-naphthalene	85			102	193						N-Formyl deriv of amine, 172
58	2,4-Dinitrophenetole 1,3-Dinitro-4-ethoxybenzene	86			67-8	193 (di)				78	2,4,6	Reduct → 2-nitro- <i>p</i> -phenetidine, 40
59	4-Chloro-1-nitro-naphthalene	87-85			98	186						
60	1,3-Dinitrobenzene	90			63	191 (di), 87-9 (mono)	240 (di), 125 (mono)	194	184			(NH <sub>3</sub> ) <sub>2</sub> S → 3-Nitroaniline, 114 Naphthalene adduct, 52
61	2,3-Dimethyl-1,4-dinitrobenzene	90			116	275-6 (di)						1-amino-2,3-dimethyl-4-nitrobenzene, 114
62	3,5-Dinitrotoluene	92		283-5		235-6 (di)						Oxid → 3,5-dinitro-benzoic acid 204-5 (NH <sub>3</sub> ) <sub>2</sub> S → 5-Nitro- <i>m</i> -toluidine 98 Oxid → 2,3-dinitro- <i>p</i> -toluic acid, 249
63	3,6-Dimethyl-1,2-dinitrobenzene	93			75							Oxid → 2,3-dinitro- <i>p</i> -toluic acid, 249
64	4,6-Dimethyl-1,3-dinitrobenzene	93			105	1-mono 165 di 295	258-9 (di)			125	4,5,6	N,N'-Diformyl deriv of amine, 182-3
65	2,4'-Dinitrobiphenyl	93		363	45	202 (di)	276-8 (di)					
66	8-Chloro-1-nitro-naphthalene	94			88-9 96	137						
67	2,4-Dinitroanisole 1,3-Dinitro-4-methoxybenzene	95										2,4-Dinitrophenol, 114, Naphthalene adduct, 50 Reduct → 2-amino-4-nitroanisole, 118, or -red. Acetyl deriv of this, 175-6
68	3-Nitroazobenzene	96, or			56-7	130-1						
69	4-Chloro-2-nitroanisole (5-Chloro-2-methoxy-1-nitrobenzene)	98			84	104	77-8		194			
70	2-Nitrophenanthrene	99, pa yel			85, pa yel	225	216					CrO <sub>3</sub> → 2-Nitrophenanthraquinone, 260, golden yel
71	8-Bromo-1-nitro-naphthalene	99-100			90	138-9						

\* Derivative data given in order m.p., crystal color, solvent from which crystallized



TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	Data for the corresponding amine obtained on reduction of all nitro groups						Nitration product		Miscellaneous
				Amine		Acet amide	Benz-amide	Benzene sulfonamide	Picrate	Melting point, °C	Position of nitro groups	
				Boiling point °C	Melting point °C							
95	4-Chloro-1,5-dinitro-naphthalene	138										NaOH → 4,8-Dinitro-1-naphthol, 235 Sn + HCl → 1,5-Diaminonaphthalene, 190, PCl <sub>5</sub> → 1,4,5-Trichloronaphthalene, 131
96	2-Nitroindene	141										Zn + Ac a → 2-indanone oxime, 155
97	4-Bromo-1,5-dinitro-naphthalene	143										NaOH → 4,8 Dinitro-1-naphthol, 235, HNO <sub>3</sub> At 180 → 3-nitrophthalic acid, 218
98	2,4-Dinitrostilbene	143 5, yel		119 20, pa yel								
99	1,3-Dinitronaphthalene	144 5, yel		96	263 5 (di)							
100	9-Nitroanthracene	146, yel		145 50	273 4							CrO <sub>3</sub> Oxid of amine → anthraquinone 273 286, yel Warm dil NaOH → 2,4 dinitro 1 naphthol, 140 Reduct → 1 amino 2 5 dimethyl-4-nitrobenzene, 144 5
101	4-Chloro-1,3-dinitro-naphthalene	146 7										
102	2,5-Dimethyl-1,4-dinitrobenzene	147, 142		150								
103	3-Nitroacenaphthene	151-2, yel		81 2	192 3	209 10			221			
104	4-Nitroazoxybenzene	153, pa yel		138	151 172							
105	3,8-Dinitroacenaphthene	155-6, br -yel		167 8, yel								
106	2-Nitrofluorene	156, 154		129	191							
107	3-Nitro-1,2-naphthoquinone	156, red										SnCl <sub>2</sub> + HCl → 3-Amino 1,2-naphthohydroquinone, 164 Dil HNO <sub>3</sub> → phthalic acid, 200 6 Oxid → 2,2'-dinitrobenzophenone, 188 9
108	2,2'-Dinitrodiphenylmethane	159		160								
109	1,6-Dinitronaphthalene	161 2, 166, pa yel		85-6, 77	257 (263) (di)	265 (di)						
110	1,8-Dinitronaphthalene	170, 173		66		311 2 (di)			218	1,3,8		
111	4-Bromo-1,8-dinitro-naphthalene	170, yel										NaOH → 4,5-Dinitro 1 naphthol, 235, HNO <sub>3</sub> At 180 → 3-nitrophthalic acid, 218, Al NH <sub>3</sub> → 4-amino-1,8-dinitronaphthalene, 246, red, Acetyl deriv of this, 245
112	3-Nitrophenanthrene	170-1		87 8	200 1	213						
113	4-Iodo-1-nitrobenzene	173		67 8	184	222						
114	1,4-Dinitrobenzene	173, 171		140, 147	304 (di), 162 3 (mono)	300 (di), 128 (di)	247 (di)					Aq NaOH → 4-nitrophenol, 114
115	3,3'-Dinitrodiphenylmethane	175		53-4	193 (di)							Oxid → 3,3'-dinitrobenzophenone, 155

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS

b) Solids ( Listed in order of increasing m.p.)\* ( Continued)

No	Name	Melting point °C	Boiling point °C	Data for the corresponding amine obtained on reduction of all nitro groups						Nitration product		Miscellaneous
				Amine		Acet amide	Benz amide	Benzene sulfon amide	Picrate	Melting point °C	Position of nitro groups	
				Boiling point °C	Melting point °C							
116	4-Nitrophenanthrenequinone	179-80, pa yel										CrO <sub>3</sub> → 6-Nitrodiphenic acid, 248-50, <i>o</i> -Phenylene diamine → quinoxaline deriv, 217-8, Monoxime, 169-70, Dioxime, 210, Monosemicarbazone, 210-11
117	4-Chloro-1,8-dinitronaphthalene	180, pa yel										NaOH → 4,5-Dinitro-1-naphthol, 235, PCl <sub>5</sub> → 1,4,5-Trichloronaphthalene, 131
118	9-Nitrofluorene	181-2		64-47	262	260-1						
119	4,4'-Dinitrodiphenylmethane	183		93	236-7 (di)							Oxid → 4,4'-dinitrobenzophenone, 189
120	4-Chloro-3-nitro-1,2-naphthoquinone	184, red										Aniline → 2-anilino-3-nitro-1,4-naphthoquinone-4-anil, 250
121	2-Nitroanthraquinone	185		303-6	262	227-8						
122	2,2'-Dinitrostilbene	196, yel		176, golden yel	304 (di)			209				
123	4,β-Dinitrostyrene	199, yel										Acid K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> → 4-nitrobenzoic acid, 240
124	3,3'-Dinitrobiphenyl	200, yel		94	257-8 (di)							
125	2,5-Dinitrofluorene	207, yel		175	289 (di)							
126	2,2'-Dinitroazobenzene	209-10, 194-5 yel		134, red	271 (di), or							
127	1,5-Dinitronaphthalene	214-217		190	360 (di)				154	1,4,5		
128	4,4'-Dinitroazobenzene	222-3, 216, or -red		250-1	212 (mono)							
129	2,5-Dinitrophenanthrenequinone	228, yel - red										Monoxime, 190-1, <i>o</i> -Phenylenediamine → quinoxaline deriv, 262-4
130	1-Nitroanthraquinone	230		252, 243	218	255						
131	2,7-Dinitronaphthalene	234, yel		166-159	261 (di)	267 (di)		210 (di)				
132	4,4'-Dinitrobiphenyl	237-240		128	317 (di), 199 (mono)	352 (di), 203-5 (mono)						
133	1,3-Dinitroanthraquinone	240, yel		290		>300						
134	1,6-Dinitroanthraquinone	255-7, yel		262, red	295 (di)	275 (di)						
135	2-Nitrophenanthrenequinone	258-60, yel		205-10, dk vlt								CrO <sub>3</sub> → 4-Nitrodiphenic acid, 217, Monoxime, 213, Monothiosemicarbazone, 234-5
136	3-Nitrophenanthrenequinone	279-80, or										CrO <sub>3</sub> → 5-Nitrodiphenic acid, 268, Monoxime, 240, Dioxime, 200, Monosemicarbazone, 254, red
137	2,7-Dinitroanthraquinone (Fritzsche's reagent)	280, 262, pa yel		>330	>350 (di)	300 (di)						

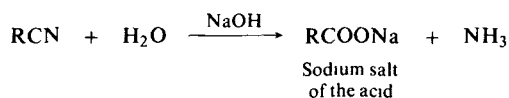
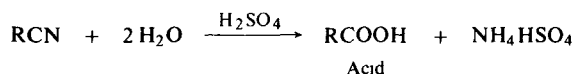
\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	Data for the corresponding amine obtained on reduction of all nitro groups						Nitration product		Miscellaneous
				Amine		Acet amide	Benz amide	Benzene sulfon amide	Picrate	Melting point °C	Position of nitro groups	
				Boiling point °C	Melting point °C							
138	<i>trans</i> -4,4 -Dinitro- stilbene	288, yel		231, yel	353 ( <i>dt</i> )	352 ( <i>dt</i> )						
139	9,10-Dinitroanthracene	294 263 yel										Oxid → anthraquinone, 273 286 yel
140	1,7-Dinitroanthra- quinone	295		290, red	283 ( <i>dt</i> )	325 ( <i>dt</i> )						
141	2,7-Dinitrophenanthrene- quinone	301 3, pa yel		> 360, dk vlt								CrO <sub>3</sub> → 4,4 Dinitrodiphenic acid, 257 8, Monoxime, 246-8, <i>o</i> -Phenylenediamine → quinoxaline deriv , 356, Fluorene adduct, 270, red -yel
142	1,8-Dinitroanthra- quinone	311 2		262, red	284 ( <i>dt</i> )	324 ( <i>dt</i> )						
143	1,5-Dinitroanthra- quinone	384-5, pa yel		319, red	317 ( <i>dt</i> )	> 350 ( <i>dt</i> )						Monoxime, 253

\*Derivative data given in order m p , crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE XXI

*Hydrolysis to the corresponding acid \**

From the nitrile and 75% sulfuric acid, or 4 l phosphoric acid-sulfuric acid

*For directions and examples see* Cheronis, pp 618, 619, Linstead, p 65, Shriner, p 258, Vogel, p 410, Wild, p 250

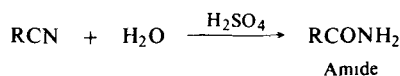
From the nitrile and potassium hydroxide in aqueous methanol, ethanol or benzyl alcohol

*See* Linstead, p 65, Vogel, pp 410, 805, Wild, p 250, L Palfray, S Sabetai and S Rovira, *Compt Rend*, 209, 483 (1939)

From the nitrile and potassium hydroxide in ethylene glycol or glycerol

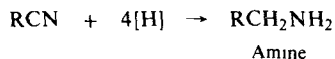
*See* Cheronis, pp 618, 620, S Rovira and L Palfray, *Compt Rend*, 211, 396 (1940)

*NOTE* For the directions and examples for the preparation of the derivatives of the carboxylic acid formed on hydrolysis see the explanations and references to Tables XII, XIII and XIV, pp 186, 187, 188, 189

*Partial Hydrolysis to the corresponding amide \**

From the nitrile with sulfuric acid

*For directions and examples see* Cheronis, pp 619, 620 Vogel, p 411

*Reduction to the corresponding amine \**

From the nitrile and sodium in absolute ethanol

*For directions and examples see* Cheronis, p 621, Shriner, p 259, Vogel, p 411, Wild, p 254, H B Cutter and M Taras, *Ind Eng Chem, Anal Ed*, 13, 830 (1941)

From the nitrile and lithium aluminum hydride in ether

*See* W G Brown in *Organic Reactions*, Vol 6 (Ed R Adams), John Wiley and Sons, New York, 1951, p 469, N G Gaylord, *Reduction with Complex Metal Hydrides*, Interscience, New York, 1956, pp 731-750

*For summary of reduction methods see* V Migrdichian, *Organic Cyanogen Compounds*, Reinhold Publishing Corp, New York, 1947, pp 151-172

*NOTE* For directions and examples for the preparation of the derivatives of the amine formed on reduction of the nitrile see explanations and references to Table XVIII, pp 291, 292, 293, 294

**\*Derivatives recommended for first trial**

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>					Miscellaneous	
						Acid		Amide	Anilide	S-Benzyl thiuronium chloride						
						B.P. °C	M.P. °C				Amine B.P. °C	Benzamide	Benzene sulfonamide	Phenyl thiourea		Picrate
1	Cyanoacetylene	42.5	5	1.38699 <sup>1</sup>	0.8159 <sup>1</sup>	144d, 83, 4 <sup>1</sup>	18	61.2	87							HgNO <sub>3</sub> → Wh precipitate. Dimer, 64.5-5.0
2	Cyanoacetaldehyde	71.2			0.881 <sup>1</sup>						45.6 <sup>1</sup>					HNO <sub>3</sub> → Cyanoacetic acid, 66, 2,4-Di nitro phenylhydrazine, 170.1, aq. al., p-Nitrophenylhydrazine, 153-4
3	Acrylonitrile	77.8		1.393 <sup>20</sup>	0.797 <sup>20</sup>	140	13	85	105							Gives solid polymer on addition of conc NaOMe sol
4	Fluoroacetonitrile	80				165	33	77								
5	Acetonitrile (Cyanomethane)	81-2		1.3442 <sup>20</sup>	0.7828 <sup>20</sup>	118		82	114	135	16.5	71	58	106, 135	165	
6	Trichloroacetonitrile	86, 83, 4			1.439 <sup>12</sup>	196.7	58	141	95-7							
7	Methacrylonitrile (α-Methylacrylonitrile)	90.1		1.399 <sup>25</sup>	0.7991 <sup>18</sup>	160	15.6	102.6								Gives solid polymer on heating with benzoyl peroxide
8	Propionitrile (Cyanopropane)	97, 103.5		1.3659 <sup>25</sup>	0.777 <sup>4</sup>	141		79	106	151	49	84	36	63	135	
9	Isobutyronitrile	104, 107.8			0.773	154.3	-47	129	109, 10	143	69	57	53	82	150	
10	Trimethylacetonitrile (tert-Butylcyanide)	106	15-6	1.3792			35	153.4	127-9							
11	2-Ethylacrylonitrile	111		1.4132		180			84, bz							
12	Dichloroacetonitrile	113			1.374 <sup>11, 5</sup>	194	5.6	98								Me ester of acid, 143-4
13	α-Chloroisobutyronitrile	116		1.4045 <sup>25</sup> , 1.435 <sup>14</sup>	1.064 <sup>14</sup>		31		69, 70							
14	n-Butyronitrile (1-Cyano-propane)	117		1.3812 <sup>24</sup>	0.796 <sup>1</sup>	162		116	96	146	77			65	151	

\*Derivative data given in order m, p, crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>					Miscellaneous	
						Acid		Amide	Anilide	S-Benzylthiuronium chloride	Amine B.P., °C	Benzamide	Benzene sulfonamide	Phenylthiourea		Picrate
						B.P., °C	M.P., °C									
15	<i>trans</i> -Crotononitrile	119		1.4217		189	72	158	115		83.4			109.5-105	131.5-2.5	n <sub>D</sub> <sup>20</sup> of amine 1.4263, 1-Naphthylthiourea of amine, 129.30
16	Allylcyanide	119		1.4060 <sup>20</sup>	0.835 <sup>15</sup>	169.63		73	58	75.7				123.7, 56.7	136.8-7.4	n <sub>D</sub> <sup>25</sup> of amine 1.4191, Al KOH → crotonic ac., 72.1-Naphthylthiourea of amine, 109.10
17	Methoxyacetone nitrile	120		1.380 <sup>28</sup>	0.9373 <sup>28</sup>	203-4		96	58							
18	2-Hydroxyisobutyronitrile (Acetone cyanohydrin)	120d	-19	1.3996 <sup>20</sup>	0.934 <sup>20</sup>		79	98	136							
19	3-Hydroxy-4-methoxybenzonnitrile	124 131.5-2.0					255.7									Acetate, 116, Acetate of acid, 206-7, Me ester of acid, 83.4, 66-7
20	2-Methylbutyronitrile	125.6		1.380 <sup>25</sup>	0.8061 <sup>20</sup>	177		112	110		95.5-6.0					HCl salt of amine, 176, H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 240
21	Chloroacetone nitrile	127			1.193 <sup>20</sup>	189	63	120	137						142-3	Addition comp with AlCl <sub>3</sub> , 38, HCl salt of amine, 144
22	Isovaleronitrile	130			0.7884 <sup>20</sup>	176		136	113, 109, 10	153	96			102	138	3-Nitrohydrogen phthalate of amine, 108
23	2,4-Pentadienonitrile	135-8		1.4880	0.8444		72	124								Me ester of acid, 50.2 <sup>20</sup>

\*Derivative data given in order m.p., crystal color, solvent from which crystallized



**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>					Miscellaneous
						Acid		Amide	Anilide	S-Benzylthiourom chloride	Amine B P, °C	Benzamide	Benzene sulfonamide	Phenylthiourea	Picrate	
						B P, °C	M P, °C									
24	2-Chlorocrotonitrile	136				212, 85, 95 <sup>10</sup>	99	212			128 31				191	Me ester of acid, 161, HCl salt of amine, 220
25	Ethoxyacetonitrile	136 7 <sup>753</sup>				156 7 <sup>16</sup>		80 2			108 <sup>750</sup>				121 3	n <sub>D</sub> <sup>25</sup> of amine 1 4108, Et ester of acid, b p 152
26	2-Methylcrotonitrile	138		1 4319	0 8313	198 5	64	75 6	77							p-Toluidide of acid, 70 5-1 5
27	2-Bromoisobutyronitrile	139-40		1 445 <sup>25</sup>				48-9	148	83						
28	4-Pentenitrile	140		1 4213 <sup>14</sup>	0 848 <sup>15</sup>	188-9		94			91 4, 98					H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 166, Thiourea deriv of amine, 43 5-4 0
29	Thiophene-2,3-dicarbonitrile (2,3-Dicyanothiophene)	140						272-4	di 228							Di-Me ester of acid, 32 3
30	3,3-Dimethylacrylonitrile	140 2			0 8292 <sup>14</sup>	199	70	107-8, 65 6	126 7		105 8		105 0 5 5	139-40d		HCl salt of amine, 193-4
31	Valeronitrile (1-Cyanobutane)	141		1 3991 <sup>15</sup>	0 8035 <sup>15</sup>	186		106	63		104		69	139		
32	2-Chlorobutyronitrile	143				189 <sup>627</sup>		75 5 6 0	74 5						142, 124	
33	Diethylacetonitrile	145				190		107			71 5				168-9	
34	2-Furanecarbonitrile (α-Furanitrile, 2-Cyanofuran)	147		1 4798 <sup>20</sup>	1 0822 <sup>20</sup>		133 4	142	124	211	145 6				150	
35	2-Methylacetacetoneitrile	147, 145 6		1 4239 <sup>20</sup>	0 9794 <sup>20</sup>	224 <sup>34</sup>	73	138-40								Semicarbazone, 153, p-Nitrophenylhydrazone, 147
36	Cyclobutane-carbonitrile (Cyanocyclobutane)	150				195		152-3, 155	112 5-3 0		110 <sup>753</sup>					HCl salt of amine, 235 5

\* Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>					Miscellaneous		
						Acid		Amide	Anilide	S-Benzylthiuronium chloride	Amine B P, °C	Benzamide	Benzesulfonamide	Phenylthiourea		Picrate	
						B P, °C	M P, °C										
37	2-Chloro-3-methylbutyronitrile	154-5			0.9922 <sup>12</sup>	210-2, 126 <sup>32</sup>	37.9									137-8, 160	Et ester of acid, b p 178-9, HCl salt of amine, 190d, H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 193.5
38	Isocaproitrile (4-Methylpentanonitrile)	155		1.4085 <sup>14</sup>	0.8071 <sup>4</sup>	199.4	-33	119, 121	111-2		125					123.5	
39	2,2-Dimethylacetoacetonitrile	163.4			1.008 <sup>11</sup>	103 <sup>1</sup>		121									Oxime, 99-100
40	2-Methylhexanonitrile	165		1.4070	0.7985	210		72	98		45-54 <sup>15</sup>						
41	3-Methoxypropionitrile	165		1.4032	0.9367 <sup>25</sup>	107 <sup>10</sup>		50			120						
42	n-Capronitrile (n-Hexanonitrile)	165	-80.31	1.4115 <sup>20</sup>	0.8093 <sup>20</sup>	205		100	95		130	40	96	77		126	HCl salt of amine 219
43	(Ethylamino) acetoneitrile (N-Ethylglycinonitrile)	166.7 81.3 <sup>20</sup>					180-2				126-9	di 117-8			di	194.5	HCl salt, 141.2
44	d,l-3-Methylhexanonitrile	171-2 <sup>19</sup>		1.4143	0.8109	212.3 <sup>55</sup>		99.100			148.9 <sup>7,6</sup>						p-Toluidide of acid, 73.4, n <sub>D</sub> <sup>20</sup> of amine, 0.7787
45	Chlorofumaronitrile	172.64 <sup>10</sup>		1.49571 <sup>20</sup>	1.2499 <sup>20</sup>		191.2		di 186								Di-Me ester of acid, b p 113.4 <sup>1</sup>
46	2-Acetoxypropionitrile (O-Acetyl lactonitrile)	172.3				167.70 <sup>78</sup>	57.60										H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 207.9
47	3-Ethoxypropionitrile	173		1.4068	0.9189 <sup>25</sup>	119 <sup>19</sup>		50			138						n <sub>D</sub> <sup>20</sup> of amine, 1.4242, D <sub>4</sub> <sup>20</sup> of amine, 0.8697
48	3-Chlorobutyronitrile	176			1.0772 <sup>9</sup>	101 <sup>11</sup>	43.4.5		89.90							147	H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 212
49	3-Chloropropionitrile	178			1.1443 <sup>18</sup>	204	41		119, w								p-Toluidide of acid, 121 HCl salt of amine, 146-8

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>					Miscellaneous	
						Acid		Amide	Anilide	S Benzylthionium chloride	Amine B P °C	Benz amide	Benzene sulfonamide	Phenyl thiourea		Picrate
						B P °C	M P °C									
50	<b>Indole-3-carbonitrile</b> (3-Cyanoindole)	178 rose				208 10										N Acetyl deriv 202 Et ester of acid 82 M p of amine 84 Me ester of acid, b p 166 7
51	<b>5-Methylhexanonitrile</b>	178 80				216		104 75	149 5							
52	<b>Thiophene-3-carbonitrile</b> (3-Cyanothiophene)	179 203 5		1 5565 <sup>21</sup>	1 1956 <sup>20</sup>		138	180								
53	<b>d l-4-Methylhexanonitrile</b>	180		1 4144	0 8141	217 8		98			152 3 <sup>30</sup>					n <sub>D</sub> <sup>20</sup> of amine, 1 4238, D <sub>4</sub> <sup>20</sup> of amine, 0 7802
54	<b>d l-Lactonitrile</b> (Acetaldehyde cyanohydrin)	182 4		1 4058 <sup>14</sup>	0 9877 <sup>20</sup>	122 <sup>1</sup>	18	79 75 6	59	153	161 2				142	
55	<b>Glycolonitrile</b> (Formaldehyde cyanohydrin)	183 sl d					80	120	97	141 146 7	171				160	Benzoyl deriv 195 6
56	<b>Heptanonitrile</b>	183 187			0 8107 <sup>20</sup>	223		95	71		155			75	121	
57	<b>4-Cyanoheptane</b>	183-4				221 2		123 4			167					Et ester of acid b p 183 H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 211 d
58	<b>Benzonitrile</b>	190	-13	1 5289 <sup>20</sup>	1 0102 <sup>13</sup>	122	129	162	167	184 5	105	88	156	194		
59	<b>Thiophene-2-carbonitrile</b> (2-Cyanothiophene)	192		1 5641 <sup>13</sup>	1 1800 <sup>15</sup>	129 30 192	180	140		58 <sup>5</sup>				181 2		HCl salt of amine, 193 4
60	<b>2-Octynonitrile</b>	194 6				148 9 <sup>19</sup>	f p 2 5	91	44							
61	<b>4-Chlorobutyronitrile</b>	196 7			1 162 <sup>10</sup>	196 <sup>22</sup>	16	88 9	60 70, bz - pet eth							

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES  
a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>					Miscellaneous	
						Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine B P, °C	Benzamide	Benz sulfonamide	Phenyl thiourea	Picrate		
						B P, °C	M P, °C										
62	Methyl cyanoacetate	200, 115 <sup>36</sup>	-22.5	1.4170 <sup>25</sup>	1.0962 <sup>25</sup>							58 <sup>15</sup>					Hydrolysis → malonic acid, 135, HCl salt of amine, 102.5, H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 192, NH <sub>3</sub> → Cyanoacetamide, 118
63	Dibenzyl acetonitrile	200.15					89	128.9	155								
64	2-Tolunitrile (2-Methylbenzonitrile)	205	-13	1.5272 <sup>25</sup>	0.9912 <sup>25</sup>		104	140	125	146		208	88			215	Acetyl deriv of amine, 69
65	2,3,3-Trimethyl-1-cyclopentene-1-carbonitrile (β-Campholtonitrile)	205, 225			0.9127 <sup>15</sup>	255-6	135	130, al	104, aq al			205.5	6.5			178	Et ester of acid, 222.5, HCl salt of amine, 175-6
66	Caprylonitrile (Octanonitrile)	206, 199		1.4224 <sup>16</sup>	0.8172 <sup>17</sup>	239	16	110	57			180				112	
67	1,1-Dicyanopropane (Ethyl malononitrile)	206 <sup>75b</sup> , 90-1 <sup>20</sup>			0.9515 <sup>11</sup>		111.5	di 216									Dihydrazide of acid, 168, al
68	Ethyl cyanoacetate	207		1.4179 <sup>20</sup>	1.0564 <sup>21</sup>					198.9							NH <sub>3</sub> → Cyanoacetamide, 118
69	1,1-Dicyanobutane (Propyl malononitrile)	210 <sup>7-10</sup>			0.9224 <sup>18</sup>		96	di 184	di 198								
70	3-Tolunitrile (3-Methylbenzonitrile)	212	-23	1.0316 <sup>20</sup>			113, 110	95	126	140		207				198, 156	Acetyl deriv of amine, 150
71	Cyclohexylacetonitrile	215		1.457 <sup>18</sup>	0.913 <sup>18</sup>	244.6	33	171-2				188-9	79-81			155.6	HCl salt of amine, 252-3, n <sub>D</sub> of amine, 1.4625
72	4,4-Dicyano-1-butene (Allyl malononitrile)	217-8	f p -12				105, eth										Di-Et ester of acid, b p 222.3, p-Nitrobenzyl ester of acid, 46, al

\*Derivative data given in order: m p, crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>					Miscellaneous	
						Acid		Amide	Anilide	S-Benzylthiuronium chloride	Amine B P, °C	Benzamide	Benzene sulfonamide	Phenylthiourea	Picrate		
						B P °C	M P °C										
73	3-Isopropylidene-1-methylcyclopentane-1-carbonitrile (β-Fencholeno-nitrile)	217.9			0.9203 <sup>1</sup>	259	72.3	86.5 7.5								Me ester of acid, 97.9	
74	3-Hydroxypropionitrile	220			1.059 <sup>u</sup>	d	syrup					188				222	Sodium salt of acid, 143. P <sub>2</sub> O <sub>5</sub> → acrylonitrile, b p 77
75	1,1-Dicyano-3-methylbutane (Isobutyl malononitrile)	222					108, bz	dt 195.6, al									
76	Nonanonitrile	224	-34.2	1.42522	0.8221 <sup>1</sup>	255	15	99	57		201	49				111	Acetyl deriv of amine, 34.5
77	2-Phenylcrotononitrile	224.6		1.5555	1.013		136	98.9									
78	Ethylenecyanohydrin	229.7 220			1.059 <sup>u</sup>						107 8 <sup>u</sup>					130, 222	Me ester of acid, b p 177.84. H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 199
79	2-Phenylpropionitrile	232				265.8		97.5		210						182	Me ester of acid, 221. M p of amine, 85. HCl salt of amine, 123.4. H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 229d
80	Phenylacetonitrile (Benzyl cyanide)	234		1.5211 <sup>1</sup>	1.0214 <sup>1</sup>		76.7	157	118	163	198	116	69	135		174, 167	
81	Phenoxyacetonitrile	239.40			1.09 <sup>1</sup>	285	98.9	101.5			228 9					167.8	HCl salt of amine, 215. HBr salt of amine, 192-3

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>					Miscellaneous
						Acid		Amide	Anilide	S-Benzylthiourom chloride	Amine B P, °C	Benz amide	Benzene sulfonamide	Phenyl thiourea	Picrate	
						B P °C	M P, °C									
82	4-Hydroxybutyronitrile	240			1.029 <sup>b</sup>	204						205.6				Acid forms readily butyrolactone, b p 204, CrO <sub>3</sub> + butyrolactone → succinic acid, 186
83	(3-Tolyl)acetonitrile ( <i>m</i> -Xylylcyanide)	240.1			1.0022 <sup>22</sup>	120-3 <sup>2b</sup>	61	141				214.5 <sup>44</sup>			176	Et ester of acid, b p 237.8, HCl salt of amine, 159
84	(4-Tolyl)acetonitrile ( <i>p</i> -Xylylcyanide)	242.3	18	1.5153 <sup>2</sup>	0.9922 <sup>22</sup>	265-7	94	185				214.5	95.6		155	Et ester of acid, b p 240, HCl salt of amine, 216-7
85	4-Isopropylbenzonitrile	243-4 <sup>44</sup>					117.8, al	153, 133				227 <sup>44</sup>				Et ester of acid, b p 263.4 HCl salt of amine, 239-40
86	(2-Tolyl)acetonitrile ( <i>o</i> -Xylylcyanide)	244			1.0156 <sup>22</sup>		88.9	161				215.5	7.0		177	HCl salt of amine, 227-8
87	Decanonitrile	245		1.4320 <sup>He</sup>	0.8294 <sup>1</sup>	269	31	100, 108	70							
88	3-Methyl-2-phenylbutyronitrile	245.9 <sup>1</sup>		1.5038 <sup>2</sup>	0.967 <sup>1</sup>	159.60 <sup>14</sup>	61.2	111.2	132.3			155-6 <sup>24</sup>				HCl salt of amine, 128
89	1,2-Dicyanopropane (Methyl succinonitrile)	252.4	12				115	<i>di</i> 225	<i>di</i> 200			172.3	154			HCl salt of diamine, 144.5
90	1-Undecanonitrile (1-Hendecanonitrile)	253.4				164 <sup>1</sup>	28.2	6	98.0	7.71						Hydrazide of acid, 101-2, Phenylhydrazide of acid, 110
91	2-Phenylvaleronitrile	254-5 <sup>30</sup>		1.5000	0.960 <sup>17</sup>	280	58	83.5				90 <sup>3</sup>				
92	10-Undecanonitrile (10-Hendecanonitrile)	257.129-30 <sup>14</sup>		1.4442 <sup>20</sup>	0.8443 <sup>20</sup>	274	24.5	87								

\*Derivative data given in order: m p, crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES  
a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>					Miscellaneous
						Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine		Benz sulfonamide	Phenyl thiourea	Picrate	
						B P °C	M P °C				B P °C					
93	3-Phenylpropionitrile	261			1.0014 <sup>18</sup>	280 <sup>754</sup>	48.5	105	98		221.5 <sup>79</sup>	57.8			152-3	HCl salt of amine, 218, H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 233
94	2-Cyanobenzal chloride (α,α-Dichloro- <i>o</i> -tolunitrile)	261					155, bz	117								
95	N-Methylanimonitrile (N-Cyano-N-methylaniline)	266	13				95, 100	163								Picrate, 195
96	3-(2-Chlorophenyl)propionitrile	267.8		1.5390	1.1390 <sup>20</sup>		96.5, w	119, bz								Me ester of acid, 255 HCl salt of amine, 167
97	1,3-Dicyano-2-methylpropane (2-Methylglutaronitrile)	269.71				205.8 <sup>12</sup>	79	<i>di</i> 175.6			78 <sup>11</sup>					Di- <i>p</i> -toluidide of acid, 174.5, n <sub>D</sub> <sup>20</sup> of amine, 1.4585
98	O-Benzoyl lactonitrile (Lactonitrile benzoate)	269-70					112	124								Di- <i>p</i> -nitrobenzyl ester of acid, 119.5
99	3-Cyanobenzal chloride (α,α-Dichloro- <i>m</i> -tolunitrile)	272.5					132									
100	4-Cyanobenzal chloride (α,α-Dichloro- <i>p</i> -tolunitrile)	273.6 <sup>770</sup>					151.8									Et ester of acid, 45.6
101	Dodecanonitrile (Lauronitrile)	276.7	4	1.43595	0.8273 <sup>15</sup>	225	44	110, 102, aq. al.	78	141	247.9					M p of amine, 28.3 Acetyl deriv of amine, 68.5, 9.5, bz, <i>p</i> -Toluene-sulfonyl deriv of amine, 73
102	1,3-Dicyanopropane (Glutaronitrile)	286		1.4365 <sup>23</sup>	0.9951 <sup>5</sup>		97	175	224		178.80	<i>di</i> 135	119	148	237	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>					Miscellaneous	
						Acid		Amide	Anilide	S-Benzylthiourom chloride	Amine B P °C	Benzamide	Benzene sulfonamide	Phenylthiourea	Picrate		
						B P °C	M P °C										
103	4-Methoxyhydrocinnamionitrile (3-(4-Methoxyphenyl)propionitrile)	290-300					104-5	125			118 20 <sup>2</sup>						Me ester of acid, 38, M p of amine, 65.7-63, HCl salt of amine, 220.5
104	1,4-Dicyanobutane (Adiponitrile)	295	0-1	1.4597 <sup>20</sup>	0.9511 <sup>18</sup>		153, 150	220	239		204.5	<i>di</i> 155	<i>di</i> 154			220	M p of amine, 42

\*Derivative data given in order m p, crystal color, solvent from which crystallized



TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

a) Liquids 2) (b.p. at reduced pressure only) (Listed in order of increasing m.p. of the corresponding acid)\*

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>					Miscellaneous	
						Acid		Amide	Amide	S-Benzylthiuronium chloride	Amine	Benzamide	Benzesulfonamide	Phenylthiourea	Picrate		
						B.P., °C	M.P., °C										B.P., °C
1	1,2,2,3-Tetramethyl-3-cyclopentene-1-acetonitrile (5-Methyl- $\alpha$ -campholenitrile)	115-9 <sup>18</sup>		1.4722 <sup>18</sup>	0.9217 <sup>18</sup>	150-15 <sup>12</sup>	35.6-7.0	99-100, lgr									
2	1-Cyano-cyclohexene	81 <sup>12</sup>		1.4818 <sup>25</sup>	0.954 <sup>25</sup>	238-40 <sup>638</sup>	38	127.8			55-7 <sup>12</sup>					181	
3	2-Hydroxybutyronitrile (Propanal cyanohydrin)	102-3 <sup>23</sup>		1.4150	0.9621	225-60d	43.4		89-90		172 <sup>755</sup>	112.1-3.1					N,O-Di- <i>p</i> -nitrobenzoyl deriv of amine, 119.2, Acetate, 43, CS <sub>2</sub>
4	Hydnocarponitrile	155-6 <sup>2-3</sup>		1.4559 <sup>25</sup>	0.8580 <sup>25</sup>		59-60	108.5d									
5	$\alpha$ -Chloro- $\alpha$ -phenylacetonitrile	131-5 <sup>13</sup>					60.1	116									
6	Butyl cyanoacetate	115 <sup>15</sup>		1.4243 <sup>25</sup>	0.998 <sup>25</sup>		66	119-20	198-9								
7	3-Bromopropionitrile	69 <sup>7</sup>		1.4789 <sup>25</sup>			62									154, yel	Nitrile + alkali → acrylic acid, <i>p</i> -toluidide of which, 141
8	2,4-Diphenylbutyronitrile	152-6 <sup>1</sup>				190 <sup>1</sup>	72.3-76	96									
9	Thiophene-2-acetonitrile	115-20 <sup>22</sup>		1.5399 <sup>25</sup>	1.153 <sup>25</sup>		76-63-4	146.7			72-4 <sup>3</sup>	61, bz-lgr		109.5-10			HCl salt of amine, 202.4, N-Acetyl deriv of amine, 45.5-6.5
10	<i>trans</i> -4-Chlorocrotonitrile	61-14 <sup>11</sup>		1.4705	1.1207	117-8 <sup>13</sup>	83	130-2									
11	2-Cyanopentanoic acid	125-30 <sup>92</sup>					96	<i>di</i> 184	<i>di</i> 198								Amide of nitrile, 124.5, Amide of nitrile, 88-9, M p of amine, 37
12	Azelaonitrile (1,7-Dicyanoheptane)	183 <sup>11</sup> , 160 <sup>3</sup>		1.4426 <sup>25</sup>			106	<i>di</i> 175	<i>di</i> 186-7		258-9						
13	3-Chloro-2-hydroxy-2-methylpropionitrile (Chloroacetone cyanohydrin)	110 <sup>22</sup>		1.4520	1.2027 <sup>15</sup>	230-5	110										
14	1,11-Dicyanoundecane (1,11-Dicyanohendecane)	189-90 <sup>7</sup>					111-2	<i>di</i> 175.6	<i>mono</i> 112.5-3.0, <i>di</i> 160.1								M p of amine, 58 HCl salt of amine, 254.5, al

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

a) Liquids 2) (b.p. at reduced pressure only) (Listed in order of increasing m.p. of the corresponding acid)\* (Continued)

No	Name	Boil ing point °C	Melt ing point °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>					Miscel- laneous
						Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benz amide	Ben zene sulfon amide	Phenyl thiourea	Picrate	
						B P °C	M P °C				B P °C					
15	2-Cyanobutyric acid	153 <sup>15</sup>					111.5	212.4								Hydrazide of acid, 95.6, Amide, 113
16	2-Cyanobiphenyl	172 <sup>15</sup>					114	177								Acid + conc H <sub>2</sub> SO <sub>4</sub> → fluorenone, 83
17	1,12-Dicyanododecane (α,ω-Dodecane dicyanide)	225.8 <sup>17</sup>					129, w	di 189	di 191, 170.1							Di-p-toluidide of acid 165 M p of amine, 61.5 HCl salt of diamine, 309.10
18	1-Cyano-4-isopropenylcyclohexene	116.8 <sup>11</sup>		1.4978	0.9439	164-5 <sup>10</sup>	132.3	164.5								
19	Sebaconitrile (1,8-Dicyanooctane)	201.3 <sup>16</sup>					134	di 210	di 198							M p of amine 60
20	Suberonitrile (1,6-Dicyanohexane)	180 <sup>12</sup>		1.4448 <sup>22</sup>			141	di 216.7	di 186.7	240.1	di 121.2			di 180		M p of amine, 52
21	3-Cyanoindene (Indene-3-carbonitrile)	140.2 <sup>13</sup>					161, 156-7	180	158							Hydrazide of acid, 186
22	Aminoacetonitrile (Glycinonitrile)	58 <sup>15</sup> , part d					262 d	65-6	62 (+2 H <sub>2</sub> O)	116.5	di 244	di 168		di 233.5		HCl salt, 165.5 6.5, M p of amine, 8.5

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point C	Boiling point C	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN + RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous		
				Acid		Amide	Anilide	S Benzyl thiuronium chloride	Amine B P C	Benz amide	Benz sulfonamide		Picrate	
				B P C	M P °C									
1	2-Cyanodiphenylmethane	19	313.4		117	163								
2	N-Piperidinoacetonitrile	19	210		215.7					182.3 58 61			di 225 220.1	Methiodide 192.3 HCl salt of acid 215.6 Phenylthiourea deriv of amine 92.3
3	3-Chloro-2-tolunitrile	19	107 <sup>28</sup>		159.154									
4	Tetradecanonitrile	19-20			54	103	82							M p of amine 37
5	Cinnamonitrile	20	255.6		133	153 109	147	175 179					181 yel aq al	HCl salt of amine 235
6	Trichloroacrylonitrile	20			76	97.8 87	98							n <sub>D</sub> <sup>20</sup> 1.5100
7	DL-Mandelonitrile (Benzaldehyde cyanohydrin)	22			118.9	133.4	151.2 146			116.7	148.9		153.4 al	M p of amine 56.5 8.0 O-Benzoyl deriv 63.4 3-Nitrobenzoyl deriv 83.4 p-Toluidide of acid 174 HCl salt of amine 208.19 acet
8	Pentadecanonitrile	23	322		52	102	78			299 301				M p of amine 34.0 6.5 HCl salt of amine 199 N-Acetyl deriv of amine 72
9	2-Methoxybenzonitrile	24.5	255.6		00.1	129	131			226.8				H-PtCl <sub>6</sub> salt of amine 187
10	(2-Chlorophenyl) acetonitrile (2-Chlorobenzyl cyanide)	25	251		95	175 w	138.9			105.8 <sup>2</sup>			187 bz	
11	1,1-Dicyanoethane (Methylmalononitrile)	26			135 138 d	di 217	di 182						di 252 d	Di-p-toluidide of acid 227.8 Di-HCl salt of amine 201
12	2-Cyanopyridine (2-Pyridinecarbonitrile Picolonitrile)	26	212.5		136.7	106.7	76			95.8 <sup>2</sup>			159 60 d	HAuCl <sub>4</sub> salt 190 N-Acetyl deriv of amine 59.60 bz-pet eth Oxalate salt of amine 166.7 d
13	4-Tolunitrile (4-Methylbenzonitrile)	27-29	217		179.80	155.165	147.8			108	137		205 15 d	D <sup>+</sup> 0.9805 M p of amine 13 N-Acetyl deriv of amine 107.8
14	D-Mandelonitrile	28.9	170 d		133	123								[α] <sub>D</sub> <sup>20</sup> +46.9 in bz
15	dl-(2-Bromophenyl) acetonitrile (2-Bromobenzyl cyanide)	29	242 d		84	143.4 144.8							150.1	Et ester of acid b p 150.2 <sup>3</sup> M p of amine 163.4 HBr salt of amine 163.4
16	(4-Chlorophenyl) acetonitrile (4-Chlorobenzyl cyanide)	30	265.7		105	175	164.5			114.6 <sup>2</sup>			212	HCl salt of amine 218.0 8.5 p-Toluene sulfonate deriv of amine 235
17	Malononitrile (Methylene cyanide)	30	218.9		135	170				136	140	96	250	n <sub>D</sub> <sup>20</sup> 1.4146 N-Acetyl deriv of amine 126
18	Hexadecanonitrile	31			63	106.7	90							D <sub>4</sub> <sup>+</sup> 0.8224
19	Maleonitrile (cis-1,2-Dicyanoethylene)	31			130	181	187	163 173		163.70	di 178.5 9.5	di 155 al	di 250 d	
20	2,2-Dicyanopropane (Dimethylmalononitrile)	31.2	169.5 subl		192.3 subl part d >130	di 269	203.4	159.60		153	di 152			Di-Me ester of acid b p 177 <sup>25</sup> HCl salt of amine 256.7

\* Derivative data given in order: m.p. crystal color solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S-Benzyl thionium chloride	Amine	Benzamide	Benzene sulfonamide		Picrate
				B.P., °C	M.P., °C								
21	<i>tert</i> -Butylacetonitrile (Neopentyl cyanide)	32-3	138	186.8		132	131						HCl salt of amine, 158.60, subl
22	1-Naphthylacetonitrile	33			131	154, 180							
23	4,4-Dicyanoheptane (Diisopropylmalononitrile)	33.4 (anh) 49.50 (hyd)	223-4, 135-40 <sup>o</sup> 2		161	<i>di</i> 214	<i>di</i> 168.05, <i>me al</i>		132 <sup>25</sup>	<i>di</i> 154			
24	Heptadecanonitrile	34			61	106			335-40	91			M.p. of amine, 49. N-Acetyl deriv of amine, 62
25	1-Naphthonitrile (1-Cyanonaphthalene)	34, 37	299		162	202			155 <sup>12</sup>		148	223	N-Acetyl deriv of amine, 134. <i>lgr</i> Methiodide deriv of amine, 213. <i>al</i>
26	2-Cyanopropionic acid	35	142.5 <sup>11</sup>		135, 120	<i>di</i> 206	<i>di</i> 182, 214						Amide, 105.81 Mono- <i>p</i> -toluidide of acid, 145d Di- <i>p</i> -toluidide of acid, 227.8. 245
27	4-Fluorobenzonitrile	35	189-90		183	154-5			183			203	
28	Coumarilonitrile (Coumarin-2-carbonitrile)	36		310-5, <i>sl d</i>	192-3, <i>w</i>	159	159						Et ester of acid, 27. Ph ester of acid, 101
29	Indole-3-acetonitrile	36.0.5	157 <sup>o</sup> 2		164-5, 199	150.1	149.5, 50				137.8	247d	Me ester of acid, 135. M.p. of amine, 116.7, 146. HCl salt of amine, 248.9. N-Acetyl deriv of amine, 77, <i>pet eth</i>
30	3-Bromobenzonitrile	38	225		155	155			244-5	135.6		205	Et ester of acid, 26. <i>b p</i> 278
31	2-( <i>N</i> -Anilino)-butyronitrile	39			141	123, <i>w</i>	92, <i>al</i>						Me ester of acid, <i>b p</i> 278.9
32	<i>trans</i> - <i>o</i> -Chlorocinnamonitrile	40			212, <i>yel, al</i>	168	176						
33	Octadecanonitrile	41.43			70	109	95.88						
34	3-Chlorobenzonitrile	41			158, 155	134	122-5		110-2 <sup>17</sup>	214		203	
35	2-Chlorobenzonitrile	43	232		141	142	118		103-4 <sup>11</sup>	116.7		217	N-Acetyl deriv of amine, 79-80. <i>O</i> -Benzoyl deriv, 57-8. Me ester of acid, 85.8, <i>bz-pet eth</i> . Me ester of acid, 39.5. 40
36	4-Chloromandelonitrile	43			119-22, 112-3	122-3							
37	Nonadecanonitrile	43			69	109.5.8	95.5-6.5						
38	2-Bromo-4-tolunitrile	44			204								
39	3,3-Dicyanopentane (Diethylmalononitrile)	44-5	195, 92 <sup>24</sup>		125, <i>w</i>	<i>mono</i> 146, <i>di</i> 224							
40	4-Cyanobutyric acid	45			97.8	182-3	<i>di</i> 221.2			105			Amide, 69.70. Et ester of acid, <i>b p</i> 245. M.p. of amine, 157.8, HCl salt of amine, 92-4. H <sub>2</sub> AuCl, salt of amine, 86.7, 106
41	5-Chloro-2-tolunitrile	45-6			169								Me ester of acid, 30-1
42	(4-Aminophenyl)acetonitrile (4-Aminobenzyl cyanide)	46	312		199	161.2							N-Benzoyl deriv, 176-7, Picrate, 185
43	<i>meso</i> -2,3-Dimethylsuccinonitrile	46			209, 198d	<i>di</i> 310-3	<i>di</i> 235						Di-Me ester of acid, <i>b p</i> 198.9

\*Derivative data given in order m.p., crystal color, solvent from which crystallized



TABLE XXI. ORGANIC DERIVATIVES OF NITRILES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point °C	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S Benzyl thionium chloride	Amine B P °C	Benzamide	Benzene sulfonamide		Picrate
				B P °C	M P °C								
64	2,4,6-Trimethylbenzotrile	55, bz	225-30		155, lgr	187-8				98-5 100 <sup>b</sup>	153-4		Me ester of acid, b p 241-2 <sup>18</sup>
65	α-Aminobenzyl cyanide	55			256	130-2, al				135 <sup>19</sup>	<i>di</i> 223-5		N-Acetyl deriv, 130-8, et ac pet eth N Benzoyl deriv, 151 Picrate, 160-1, yel NH <sub>4</sub> salt, 183
66	Cyanoform (Tricyano methane)	55-6 pet eth											
67	Succinonitrile	56-6	265-7		186-8	260	230	149	159	177		250-5	M p of amine, 27 N-Acetyl deriv of amine 137
68	2-Iodo-4-tolunitrile (2-Iodo-4-methylbenzotrile)	57-8			205-6	167							
69	2,6-Dinitrobenzotrile	58 (145)			202-3								Me ester of acid, 147 M p of amine, 88, HCl salt of amine, 185, H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 193
70	<i>d,l</i> -2,3-Dimethylsuccinonitrile	58-9	.....		135	<i>mono</i> 148-9, <i>di</i> 244	<i>di</i> 222						Di-Me ester of acid, b p 200
71	2-Chloro-4-tolunitrile	61-2			155-6	182							
72	4-Methoxybenzotrile	61-2	256-7		184-6	162-3	169	177 184-5	236-7				N-Acetyl deriv of amine, 96, H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 210
73	2,4-Dichlorobenzotrile	61-2			164-160	194			140 <sup>122</sup>				Me ester of acid, b p 132 <sup>15</sup> , n <sub>D</sub> <sup>25</sup> of amine 1-5738, HCl salt of amine, 281-2-4-3
74	4-Methoxycinnamotrile	64			170	186							Me ester of acid, 90 Et ester of acid, 49-50
75	3,5-Dichlorobenzotrile	65, subl			188				254 <sup>0</sup>			241	Me ester of acid, 58, n <sub>D</sub> <sup>25</sup> of amine 1-5690, HCl salt of amine, 300
76	<i>cis</i> -1,4-Dicyanocyclohexane	65			168-9								Acid + conc HCl at 180 → <i>trans</i> isomer, 300
77	Bromomalononitrile	65-6			113d	181							Di- <i>p</i> -toluidide of acid, 217
78	2-Naphthonitrile (2-Cyanonaphthalene)	66-62	305		184	192, 195						226	M p of amine, 60 N-Acetyl deriv of amine, 126, Methiodide deriv of amine, 168, al
79	Cyanoacetic acid	66			135-6	170	226-7			120 w			Amide, 119-20, Anilide, 198-9, Warming with benzaldehyde → α-cyanocinnamic ac, 180, M p of amine, 200, HCl salt of amine, 123
80	2-Cyano-2-ethylbutyric acid (Diethylcyanoacetic acid)	66-57	240-5, 164 <sup>a</sup>		125, w	<i>mono</i> 146, <i>di</i> 224							NH <sub>3</sub> → Diethylcyanoacetamide, 121

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S-Benzyl thuronium chloride	Amine B P, °C	Benzamide	Benzene sulfonamide	Picrate		
				B P, °C	M P °C									
81	2,4-Diphenylglutaronitrile	66, 70 l	220-7 <sup>5</sup>		2 forms (a) 164-5, w, (b) 185-6, chl - pet eth									Di-HCl salt of amine, 319 20, iso-PrOH
82	α-Chloro-3-tolunitrile	67, al	258 60		132, w	124							173	HCl salt of amine, 169, H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 219
83	4-Chloro-2-tolunitrile	67			172	183								
84	1-Cyanoacenaphthene (Acenaphthene 1-carbonitrile)	68			161									
85	Phenylmalonitrile (α-Cyanobenzyl cyanide)	69			152 3	233								
86	6-Nitro-2-tolunitrile	69 70			184	163								
87	(4-Hydroxyphenyl) acetoneitrile (4-Hydroxybenzyl cyanide)	69 70, w	330		148-50	175							200	Me ester of acid, 66 Acetate, 49 50 M p of amine, 160 l
88	5-Bromo-2-tolunitrile	70			187	180								
89	α-Bromo-2-tolunitrile (2-Cyanobenzyl bromide)	71 2	124 <sup>4</sup>		147									Me ester of acid, 32 0- 5
90	2,2-Diphenylglutaronitrile	71 2 5			195-7, 183	1-mono 142-4								Anhydride of acid, 134, Imide of acid, 158 9
91	(2-Aminophenyl)acetoneitrile (2-Aminobenzyl cyanide)	72			119	93								N-Acetyl deriv, 120, Benzamide, 175-9, N-Acetyl deriv of acid, 158
92	3,4-Dichlorobenzonitrile	72			208 9	133			139 40 <sup>17</sup>				228	Me ester of acid, 46 5 7 5, HCl salt of amine 240 2
93	1,2,2,3-Tetramethylcyclopentene-1-carbonitrile (Campholic nitrile)	73	217 9	255	106	80	91, al		210	98				
94	Dicyanodimethyl amine (Bis(cyanomethyl) amine)	75, 77			247 5, 225d	di 143	di 140 5		208	tri 166, chl		tri 212d		N-Nitroso deriv, 43, N-Benzoyl deriv, 131 2, Tri-HCl salt of amine, 233
95	Diphenylacetoneitrile (α-Phenylbenzyl cyanide)	75			148	168	180	145	134 <sup>2</sup>	144-5		211 2 d		M p of amine, 42 3 5, HBr salt of amine, 205 7
96	4-Cyano-N,N-dimethylaniline	75 6	318		242 5-3 5	206	182-3							Me ester of acid, 102, HCl salt of amine, 212
97	1-Cyanoisoquinoline	78, 93			161									
98	4-Cyanopyridine	78, 83			315	155-6			120 5 <sup>12</sup>			179-80, al		HCl salt, 199, HAuCl <sub>4</sub> salt, 208 10
99	α-Chloro-4-tolunitrile (4-Cyanobenzyl chloride)	78-80, al	263		203	173							185	H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 226
100	2,5-Diphenylvaleronitrile	79			80-1, lgr									
101	3-Cyanobenzaldehyde (3-Formylbenzonitrile)	79-81			175, w	190d								Oxime, 99-101, w, Semicarbazone of acid, 265, Phenylhydrazone of acid, 164

\* Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point °C	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S-Benzylthiuronium chloride	Amine	Benzamide	Benzene sulfonamide		Picrate
				B P, °C	M P, °C								
102	6-Nitro-3-tolunitrile	80			219	151							Me ester of acid, 81-2, Et ester of acid, 55, al
103	Benzoylacetoneitrile	81			103-4d	113	108						155d
104	6-Chloro-2-tolunitrile	82 3			102	167							Carbazone of acid, 125, HCl salt of amine, 128
105	8-Cyanoquinoline	84, 50% al			187	171-3, w							Me ester of acid, 104 Et ester of acid, 38 b p 175-7 <sup>7</sup>
106	2-Nitro-3-tolunitrile	84			223	192							Me ester of acid, 74, me al
107	2,3,4,5-Tetrachlorobenzonitrile	84			194 5	207 8, acet - al	197, al						M p of amine 90 1
108	4-Cyanobiphenyl	85 6			228	223				195-200 <sup>15</sup>			Me ester of acid, 117 8, M p of amine, 128 HCl salt of amine, 308 10 282
109	2-Naphthylacetoneitrile	86, 81			142	200							
110	cis-2,3-Diphenylacrylonitrile	86	228 30 <sup>23</sup>		137-8	167-8, chl - lgr	179, chl - pet eth						
111	4-Aminobenzonitrile (4-Cyanoaniline)	86			188	182 9				268 70			N-Acetyl deriv , 205, N-Benzoyl deriv , 170 Picrate, 150
112	1-Cyano-2-phenylacrylonitrile (Benzalmononitrile)	87			195-6d	di 189-90							Di-Me ester of acid, 44 Di-Et ester of acid, 32
113	5-Bromo-2,4-dimethylbenzonitrile	88 90			180-1	197 5-8 5							
114	2-Cyanotriphenylmethane	89	270-85 <sup>20-30</sup>		162								Me ester of acid, 98, me al
115	5-Cyanoquinoline	89 (anh), 70 (+1 5 H <sub>2</sub> O)			342								Picrate, 241, Styphnate, 241d, yel HCl salt 248, yel, Me ester of acid, b p 128-32 <sup>9 2</sup>
116	2,6-Dimethylbenzonitrile	90 1			116	138 5-9 0, 120-5				96-8			Me ester of acid, b p 94 <sup>9</sup>
117	Phenylcyanoacetic acid	92											Amide, 147, Anilide, 136
118	2-(N-Anilino)propionitrile	92, al			162, w	144	127, al						Et ester of acid, b p 272
119	2,4-Dibromobenzonitrile	92			174	198							Me ester of acid, 33
120	β-(2-Nitrophenyl)acrylonitrile	92, w	194-6 <sup>7-8</sup>		cis 146-7, yel, trans 240	185							Et ester of acid, 60
121	5-Chloro-2-nitro-4-tolunitrile	93			180-1								
122	α-Bromo-3-tolunitrile (3-Cyanobenzyl bromide)	93, al			155-6								
123	4-Nitro-3-tolunitrile	93-4			134	176-7							Me ester of acid, 78 9, me al
124	2-(N-Anilino)isobutyronitrile	93-4, al			184-5, w	136	155, al						
125	2-Cyanoquinoline	94			157	133, 123							

\*Derivative data given in order m p, crystal color, solvent from which crystallized



**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S-Benzylthiuronium chloride	Amine B P, °C	Benzamide	Benzene sulfonamide	Picrate		
				B P, °C	M P, °C									
126	4-Cyanovaleric acid (2-Methylglutaromononitrile)	95.6, w		205-8 <sup>12</sup>	79	<i>dt</i> 175.6								Di- <i>p</i> -toluidide of acid, 74.5; H <sub>2</sub> PtCl <sub>6</sub> salt of amine 202.3
127	Fumaronitrile	96			295, 300	266	313-4	178, 182						
128	4-Chlorobenzonitrile	96, 94.6	223, 95 <sup>5</sup>		240	179, 170	194		217	140		210		
129	9-Phenanthrylacetonitrile	96.5-7.0			224.5	250-2								
130	3,5-Dibromobenzonitrile	97, subl			219.20	187								Me ester of acid, 63
131	2-Chloro-3-nitrobenzonitrile	97-101, pa yel			185									Me ester of acid, 70. Et ester of acid, b p 314d
132	2-Hydroxybenzonitrile (2-Cyanophenol)	98		211 <sup>20</sup>	159	133	135							D <sub>4</sub> <sup>99</sup> 1.1052, n <sub>D</sub> <sup>20</sup> 1.53716. O-Benzoyl deriv., 106, pet eth., M p of amine, 125, 129, H <sub>2</sub> PtCl <sub>6</sub> salt of amine 197d. HI salt of amine, 184
133	4-Chloro-2-nitrobenzonitrile	98			142	172								Me ester of acid, 42-3
134	4-Cyanotriphenylmethane	100, me al			165, ac a		196, ac a							
135	4-Chloro-3-nitrobenzonitrile	100.1			181-2	156	131					210d		Me ester of acid, 83. HCl salt of amine, 227.8
136	3-Nitro-4-tolunitrile	101			164.5	153								Amide, 130, Di-Me ester of acid, 35.6
137	2-Cyano-3-phenylpropionic acid	101.2, 75			120-1	225								
138	3-Cyanophenanthrene	102			269	233.4, 227-8	216.7							
139	2,3,3-Triphenylpropionitrile	102, me al			222-3, al	213								Me ester of acid, 162. HCl salt of amine, 269.72
140	4-Cyanoquinoline	102			253.4	181								Methodide, 216. H <sub>2</sub> AuCl <sub>4</sub> salt, 232. Di-HCl salt of amine, 255d. Me ester of acid, 42
141	4-Bromo-1-naphthonitrile (1-Bromo-4-cyanonaphthalene)	102-3			212, 220									
142	4-Bromo-2,5-dimethylbenzonitrile	103-4			171.5-2.5	209-10								
143	5-Nitro-3-tolunitrile	104.5			174	164-5								Me ester of acid, 84-5
144	2,4-Dinitrobenzonitrile	104.5, al			182-3	203-4								Me ester of acid, 70. Hydrazide of acid, 231.3. Me ester of acid, 69. Me ester of acid, 73.
145	4-Nitro-2-tolunitrile	105			179	173.4								
146	6-Chloro-3-nitrobenzonitrile	105-6			165	178								
147	5-Bromo-3-nitro-2-tolunitrile	106-7			226	235								
148	2-Nitro-4-tolunitrile	107, pa yel			190	166								
149	9-Cyanophenanthrene	107, 111.0-3			256.5-7.0	232-3, 226	218			167		241		M p of amine, 108.5. HCl salt of amine, 294. N-Acetyl deriv of amine, 182.3. Picrate of acid, 217-8
150	3-Cyanoquinoline	108			275	198-9, 195								

\* Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S Benzyl thiu ronium chloride	Amine B P, °C	Benz- amide	Ben zene sulfon- amide		Picrate
				B P, °C	M P °C								
151	2-Cyanophenanthrene	109			259 60	242 3	217 8						
152	3-Nitro-2-tolunitrile	109 10			151 2 pa yel	158							Me ester of acid, 50
153	2-Nitrobenzonitrile	110			146	174 6	155						HCl salt of amine, 248 50
154	4-Chloro-1-naphtho- nitrile (1-Chloro-4- cyanonaphthalene)	110			223-4, 210	235 6							
155	5-Cyanoacenaphthene (Acenaphthene-5- carbonitrile)	110 1			219, bz	198				182-4	148-9		
156	4-Bromobenzonitrile	112	235 7		251	189 90			250	143		221	M p of amine, 20 N- Acetyl deriv of amine 113
157	2,4,5-Trimethoxybenzo- nitrile	112 4, al		ca 300	144, bz - pet eth	184 5	154 5						Me ester of acid, 97 5 Et ester of acid, 72
158	4-Hydroxybenzonitrile (4-Cyanophenol)	113			213-4	162 (+1 H <sub>2</sub> O)	196 7						M p of amine, 109 (anh ), 95 (+1H <sub>2</sub> O) HCl salt of amine 195 HI salt of amine 198 200
159	2,3-Diphenylvaleronitrile (2 forms)	(a) 115 al	(a) 235 40 <sup>20</sup> (b) 210 2 <sup>20</sup>		(a) 152- 3 (b) 178 lgr								
160	α-Bromo-4-tolunitrile (4-Cyanobenzyl bromide)	115 6 al			229 30								Me ester of acid, 54 Et ester of acid, 35 6
161	(4-Nitrophenyl)aceto- nitrile (4-Nitrobenzyl cyanide)	116			153	197 8 191	198						
162	6-Bromo-3-nitrobenzo- nitrile	117			180	197 8	166						
163	(2-Hydroxyphenyl) acetoneitrile (2-Hy- droxybenzyl cyanide)	117 9		240 3	147 9	116 8, al		163					O-Benzoyl deriv 50, lgr HCl salt of amine, 155
164	3-Nitrobenzonitrile	118			140	141-3	153 4						HCl salt of amine 224
165	4-Bromo-3-nitrobenzo- nitrile	120			203 4	156							
166	4-Cyanoazobenzene	120 1, br , bz			241, red, al	224-5, red							Me ester of acid, 123 4, or , me al , Et ester of acid, 86-7, red, al
167	Dipicolonitrile (2,6- Dicyanopyridine)	123 113			252d 228	di 302							Di-Me ester of acid, 124 5 Di-Et ester of acid, 41 2
168	2-Cyanohexanoic acid	123-6 5			101	di 200	di 193						
169	Dibromomalononitrile (Bromodicyano- methane)	124			147d 136- 7d	di 200, 206d							Di-Me ester, 67
170	1-Cyanoanthracene	126			245, yel , al	260							Me ester of acid, 108, yel , ac a
171	2,2,3-Triphenylpropio- nitrile	126			162 132	111, al							Me ester of acid, 127
172	1-Cyanophenanthrene	128			232-3	284	245						

\* Derivative data given in order m p , crystal color, solvent from which crystallized



TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benz- amide	Ben zene sulfon- amide		Picrate
				B P. °C	M P °C								
195	5-Iodo-2-naphthonitrile (2-Cyano 5 iodo-naphthalene)	148.5			264, al	196	203						M p of amine, 120 HCl salt of amine, 251.3 N-Acetyl deriv amine 135-6
196	3-Cyano-3-phenylpropionic acid	150	215.8 <sup>10</sup>		166-7								Di-Me ester of acid, 55, al, Imide of acid, 88-90, M p of amine, 209 HCl salt of amine, 203, N-Acetyl deriv of amine, 65
197	2-Cyano-2-propylvaleramide (Dipropylcyanoacetamide)	153			161	di 214	di 168.85, me al						
198	2,6-Dibromobenzonitrile	155, subl	308.9		157	208.5							Me ester of acid, 83 Hydrazide of acid, 204
199	3-Chloro-4-hydroxybenzonitrile	155			169-70, w, 164.5	180-2							Me ester of acid, 106.7, Et ester of acid, 77-8
200	5-Chloro-2,4-dinitrobenzonitrile	156			182.3	212	226						
201	4-Benzamidobenzonitrile (N-Benzoylanthranilonitrile)	156			181	218.9	279						Me ester of acid, 100 Et ester of acid 98
202	5-Bromo-2-hydroxybenzonitrile	158-9			165	232	222						O-Acetyl deriv of acid, 60
203	d l-2,3-Diphenylsuccinonitrile	160			183 (+ l H <sub>2</sub> O)		mono 173.5, al						
204	Isophthalonitrile (m-Dicyanobenzene)	161.5, 2.0			345.7	di 280							
205	2-Hydroxy-4-nitrobenzonitrile (2-Cyano-5-nitrophenol)	160.1, yel			235, 226, w	192.4							Benzoate, 122, yel, al, Et ester of acid, 84-5
206	d l-4-Cyano-3,4-diphenylbutyric acid (d l-2,3-Diphenylglutaromononitrile)	162.3, bz			208-10 (cor), aq ac a	mono 200-5, d, al	mono 201-2, 50% al						Et ester, 99-100, al, Imide of acid, 225-9, aq al
207	d-3-Carboxy-2,2,3-trimethylcyclopentylacetonitrile	164				233, PhNO <sub>2</sub>							[α] <sub>D</sub> +64.41, Me ester, 77, Et ester, 58
208	5-Chloro-2-hydroxybenzonitrile (4-Chloro-2-cyanophenol)	165-7			172, 167.5	226							Me ester of acid, 84
209	2,3-Diphenylcinnamonitrile (Cyanotriphenylethyene)	166.7, 162-3			213	223							
210	1,7-Dicyanonaphthalene	167, al			294-6								
211	4,4'-Dicyanodiphenylmethane	169			334, 290								Di-Me ester of acid, 81.2
212	2,2'-Diphenic acid mononitrile (2-Carboxy-2'-cyanobiphenyl)	170.2, bz			233.5	mono 193, di 212	mono 181-3						Di-Me ester of acid, 74, Me ester, 110, Et ester, 91-2
213	5-Nitro-2-naphthonitrile (2-Cyano-5-nitro-naphthalene)	172-3			295, yel	261-3, br -yel							Me ester of acid, 112, yel

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S-Benzylthio ronium chloride	Amine		Picrate		
				B P °C	M P °C				B P °C	Benzamide			Benzene sulfonamide
214	9-Cyanoanthracene (9-Anthracenecarbonitrile)	175, 170-2			207, pale								Me ester of acid, 111, M p of amine, 90
215	2,3-Dicyanopyridine	175.6			228.9	2-mono 168.5 d, di 165							
216	1,3-Dicyanonaphthalene	179, ac a			267.8								
217	3-Cyanocoumarin	182			187 d	236	250						Me ester of acid, 116.7 Et ester of acid, 64
218	2-Cyanocinnamic acid	183, al			195.6 d	di 189-90							NH <sub>3</sub> → 2-Cyanocinnamamide, 123 Me ester of nitrile 89 Di-Me ester of acid, 44.5
219	2-Cyanobenzoic acid	187, 192			200.6	di 219	di 253	di 151, 157		di 184	170		NH <sub>3</sub> → 2-Cyanobenzamide, 173 Me ester 51 Et ester, 70.65
220	1,2-Dicyanonaphthalene	190, bz			175	di 265							p-Nitrobenzoyl ester of acid, 115
221	2-Hydroxy-5-nitrobenzotrile (2-Cyano-4-nitrophenol)	194-6, yel, w			229-30, 227	225, al							
222	Tetracyanoethylene	198, 200, subl	223										ng <sup>5</sup> 1560 D <sup>2</sup> 1348 N,N-Dimethylaniline → N,N-dimethyl 4-tricyanovinylaniline 173.5, ac a Anthracene → adduct, 268.70, acet
223	5-Nitro-1-naphthonitrile (1-Cyano-5-nitro-naphthalene)	205			241.2, 239	235.6							Me ester of acid, 109-10, Et ester of acid, 93
224	1,4-Dicyanonaphthalene	208, ac a			309, 288								Di-Me ester of acid, 67 Di-Et ester of acid, 64
225	1,6-Dicyanonaphthalene	208-10			310								Di-Me ester of acid, 99
226	1,5-Dicyanonaphthalene	211, 266-7			310, ac a								Di-Me ester of acid, 114.5 Di-Et ester of acid, 123-4
227	3-Cyanobenzoic acid	217			345	280							NH <sub>3</sub> → 3-Cyanobenzamide, >300 Me ester, 65, Et ester, 56
228	4-Cyanobenzoic acid	219			ca 300, subl	di >250	di 334-7				232 d		NH <sub>3</sub> → 4-Cyanobenzamide, 223, Me ester, 62, Et ester, 54
229	Terephthalonitrile (p-Dicyanobenzene)	222			ca 300, subl	di >250	di 334-7				232 d		N,N'-Diacyl deriv of diamine, 225
230	1,8-Dicyanonaphthalene	232			260	di 250-82 d							Di-Me ester of acid, 102.3, Di-Et ester of acid, 58.60
231	4,4'-Dicyanobiphenyl	233.4											Di-Me ester of acid, 214 224, Di-Et ester of acid, 112, Heating acid with lime → biphenyl, 71
232	l-2,3-Diphenylsuccinonitrile	239.40			176-7, 190, w								Imide of acid, 196.8, ac a

\*Derivative data given in order m p, crystal color, solvent from which crystallized

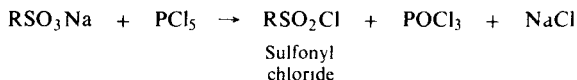
**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous
				Acid		Amide	Anilide	S Benzylthiouromium chloride	Amine	Benzamide	Benzene sulfonamide	Picrate	
				B P °C	M P °C				B P °C				
233	1-Cyano-9,10-anthraquinone	247, yel, ac a		293 4, pa yel, ac a	280, pa yel, al	288-9, pa yel, PhNO <sub>2</sub>							Me ester of acid, 189, yel, Et ester of acid, 169, yel
234	2,3-Dicyanonaphthalene	251, al		239-41									Imide of diacid, 275
235	2,7-Dicyanonaphthalene	267 8, ac a		> 320	<i>dt</i> 297-8								Di-Me ester of acid 135-6
236	2,6-Dicyanonaphthalene	293, al		> 300 d	<i>dt</i> > 320								Di-Me ester of acid, 191

\*Derivative data given in order m p, crystal color, solvent from which crystallized

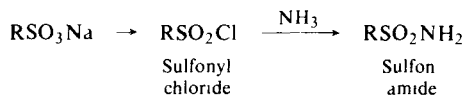
## EXPLANATIONS AND REFERENCES TO TABLES XXII AND XXIII

The main derivatives of the sulfonic acids are obtained by converting them to the corresponding sulfonyl chlorides. Hence sulfonic acids and sulfonyl chlorides are often identified through the same derivatives.

*Sulfonyl chloride*

From the sulfonic acid or its sodium or potassium salt with phosphorus pentachloride without solvent.

*For directions and examples see* Cheronis, p 638, Linstead, p 89, Shriner, pp 268, 270, Vogel, p 553, Wild, p 161

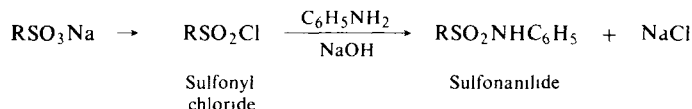
*Sulfonamide \**

From the sulfonyl chloride (prepared from the acid or its salt) and concentrated aqueous ammonia solution.

*For directions and examples see* Linstead, p 49, Shriner, pp 268, 270, Vogel, p 553, Wild, p 161

From the sulfonyl chloride, aqueous ammonia and ammonium carbonate.

*See* Cheronis, p 639

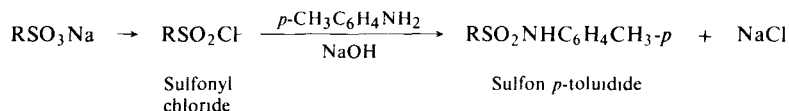
*Sulfonanilide \**

From the sulfonyl chloride (prepared from the acid), aniline, and sodium hydroxide.

*For directions and examples see* Linstead, p 89, Wild, p 161

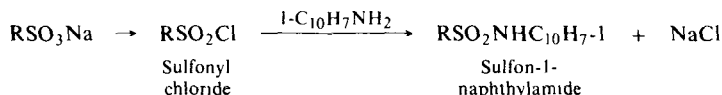
From the sulfonyl chloride and aniline.

*See* Vogel, p 553

*Sulfon-p-toluidide \**

From the sulfonyl chloride, *p*-toluidine and aqueous sodium hydroxide.

*For directions and examples see* Vogel, p 553

*Sulfon-1-naphthylamide \**

From the sulfonyl chloride (prepared from the acid) and 1-naphthylamine in benzene.

*For directions and examples see* Cheronis, p 639

*S-Benzylthiuronium salt \**

From the sodium, potassium or ammonium salt of the sulfonic acid and S-benzylthiuronium chloride in water.

*For directions and examples see* Cheronis, pp 635, 636, Linstead, pp 15, 89, Shriner, p 269, Wild, pp 149, 159, E. Chambers and G. W. Watt, *J. Org. Chem.*, **6**, 376 (1941), E. Campaigne and C. M. Suter, *J. Amer. Chem. Soc.*, **64**, 3040 (1942), S. Veibel, *J. Amer. Chem. Soc.*, **67**, 1867 (1945)

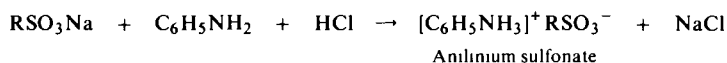
**\*Derivatives recommended for first trial**

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives.

## EXPLANATIONS AND REFERENCES TO TABLE XXII AND XXIII (Continued)

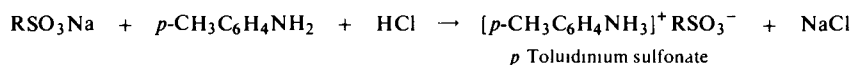
From sodium or potassium sulfonate and S-benzylthiuronium chloride in alcohol  
See J J Donleavy, *J Amer Chem Soc*, **58**, 1004 (1936)

### Anilinium salt \*



From the sodium or potassium salt of the acid, aniline and hydrochloric acid in water  
For directions and examples see Cheronis, p 637, O C Dermer and V H Dermer, *J Org Chem*, **7**, 581 (1942)

### *p*-Toluidinium salt \*



From the sulfonic acid and *p*-toluidine

For directions and examples see Shriner, p 269

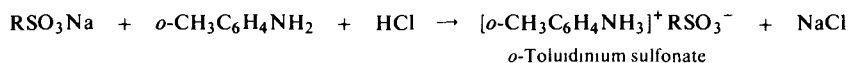
From the sodium, potassium or ammonium salt with *p*-toluidine or *p*-toluidine hydrochloride in water

See Shriner, p 269, Vogel, p 555, O C Dermer and V H Dermer, *J Org Chem*, **7**, 581 (1942), A D Barton and L Young, *J Amer Chem Soc*, **65**, 294 (1943)

From the sodium, potassium, ferric or barium salt (after boiling with sulfuric acid) with *p*-toluidine and hydrochloric acid

See Cheronis, p 637, Fieser, *J Amer Chem Soc*, **51**, 2460 (1929)

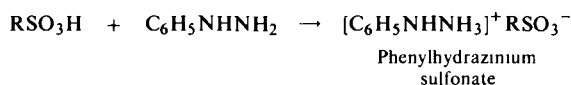
### *o*-Toluidinium salt \*



From the sodium or the potassium salt of the sulfonic acid with *o*-toluidine and hydrochloric acid in water

For directions and examples see Cheronis, p 637, O C Dermer and V H Dermer, *J Org Chem*, **7**, 581 (1942)

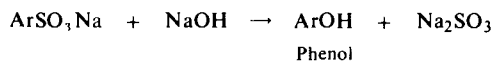
### Phenylhydrazinium salt \*



From the sulfonic acid with phenylhydrazine in water-alcohol

For directions and examples see Wild, p 159, P H Latimer and R W Bost, *J Amer Chem Soc*, **59**, 2500 (1937)

### Phenols by KOH fusion



By fusion of the sodium arylsulfonate and sodium hydroxide in a nickel crucible

For directions and examples see Vogel, p 552

By fusion of the sodium arylsulfonate, potassium hydroxide and zinc dust

See Linstead, p 89

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives



TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS

a) Listed in order of increasing m.p. of the corresponding sulfonamide\*

No	Name	Melting point °C	S-Benzylthiuronium salt	p-Toluidinium salt	Anilinium salt	o-Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonanilide	Sulfon-1-naphthylamide	Miscellaneous
1	Propane-1-sulfonic acid			67-8			b p 180	52, eth		84	Phenylhydrazine salt, 204 5
2	Ethane sulfonic acid		115				b p 171	60, eth		66	Phenylhydrazine salt, 182 8
3	Propane-2-sulfonic acid	-37					b p 79 <sup>18</sup>	60, eth - pet eth		134	B p 159 <sup>14</sup> , D <sub>4</sub> <sup>25</sup> = 1 1877, n <sub>D</sub> <sup>20</sup> = 1 4332, m-T u- dide, 109
4	Heptane-1-sulfonic acid						16	75			Phenylhydrazine salt, 100 0 5
5	2,4,5-Trimethoxybenzene sulfonic acid						130	76	170		
6	Methane sulfonic acid	20					b p 60 <sup>21</sup>	90	100	125-6	Phenylhydrazine salt, 193 5-4d
7	Hexadecane-1-sulfonic acid (Cetyl sulfonic acid)	54					54	97			
8	10-Bromocamphor-3-sulfonic acid						97	100 2			
9	Benzyl sulfonic acid			113, al	102	83	92 3, eth, bz	105, w, al	102, al	166 (146), yel, al	Diethylamide, 29, Ethylamide, 65-6, Hydrazide, 131-2, Methylamide, 109- 10, Phenylhydra- zine salt, 173
10	3-Toluene sulfonic acid (3-Methylbenzene sulfonic acid)	oil		106		108	12	108, al	96, al		
11	3-Hydroxynaphthalene-2-sulfonic acid				241 2		112	110			
12	Pyridine-3-sulfonic acid	357					Hydrochloride, 141-4 d	110 1	145		Diethylamide, 49- 50, Hydrazide, 94, me al
13	2,6-Dimethylbenzene sulfonic acid	98					39	113 (96)			
14	2-(N-Methylamino)benzene sulfonic acid	182 d						114 5 5 5			N-4-Toluene sulfonyl, 193
15	Indane-4-sulfonic acid						53 3 5	118-9, w			
16	2-Phenylethane-1-sulfonic acid	91					33	122	77		
17	4-Formylbenzene sulfonic acid (Benzaldehyde-4-sulfonic acid)							122-4			Amide oxime, 185, Dimethylamide, 134-7, Di-O-ace- tate, 86-7 5, Chlo- ride diacetate, 111-3
18	2-Methylnaphthalene-1-sulfonic acid						83-5	124			
19	4-Fluorobenzene sulfonic acid						36 (30)	125 (123), w			
20	4-Chloro-3-methylbenzene sulfonic acid						65	128	92		Sulfonyl bromide, 67 5
21	3-Chloro-4-methoxybenzene sulfonic acid						82	131			
22	3-Ethoxybenzene sulfonic acid						38	131			
23	D-Camphor-10-sulfonic acid	193					67	132	121		
24	2-Fluoronaphthalene-6-sulfonic acid	105					97, chl	133	129		
25	DL-Camphor-8-sulfonic acid	56 8					106	133-5, w			
26	3-Methyl-4-nitrobenzene sulfonic acid						50	133 5			
27	3-Chloro-4-methylbenzene sulfonic acid						38	134	96		
28	3,5-Dimethylbenzene sulfonic acid			121-2, al			94 (90), bz	135, al	119, al		

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS**  
**a) Listed in order of increasing m.p. of the corresponding sulfonamide\* (Continued)**

No	Name	Melting point °C	S-Benzylthiuronium salt	p Tolu-dinium salt	Anilinum salt	o Tolu-dinium salt	Sulfonyl chloride	Sulfonamide	Sulfonamide	Sulfonamide	Miscellaneous
29	Indane-5-sulfonic acid	92					46-7, eth	135 5 6, al	129, al		
30	D-Camphor-8-sulfonic acid						138, ([ $\alpha$ ] <sub>D</sub> <sup>25</sup> + 128 7 in chl )	137, ([ $\alpha$ ] <sub>D</sub> <sup>25</sup> + 93 6 in al )			
31	4-Toluene sulfonic acid (4-Methylbenzene sulfonic acid)	104 5 (92)	181-2	198	238	190	71, eth	anh 138 5 9, dihyd 105	103, eth -al	157, al	Phenylhydrazide, 155, al, o-Toluidide, 110, aq ac a, Triethylammonium salt, 65
32	2,4-Dimethylbenzene sulfonic acid	62 (hvd)	146				34	139 (137)	110		
33	4-Vinylbenzene sulfonic acid (4-Styrene sulfonic acid)			182 3				139 40			Dimethylamide, 62 3
34	3,4-Dichlorobenzene sulfonic acid						22 4 (19)	140 (135)			
35	2-Bromonaphthalene-1-sulfonic acid						97	140			
36	2,4,6-Trimethylbenzene sulfonic acid	77					56	142	109		
37	3-Aminobenzene sulfonic acid (Metanilic acid)		148					142			
38	D-Camphor-2-sulfonic acid			196 7			88	143	124		Me ester 77, ([ $\alpha$ ] <sub>D</sub> + 98 6 in chl )
39	4-Methylnaphthalene-2-sulfonic acid						124-5, eth	143 4, al			
40	3,4-Dimethylbenzene sulfonic acid	64	208				52	144			
41	4-Chlorobenzene sulfonic acid	93	175	208 10	222 3	163 4	53	144	104	190	
42	4-Methyl-3-nitrobenzene sulfonic acid	92 hyg		130	109	128	36	144 5		153	
43	3-Bromocamphor-8-sulfonic acid	195 6 (anh)					136 7	145			
44	5-Chloro-2-methylbenzene sulfonic acid						24 (21)	145, aq al			
45	4-Bromo-3-methylbenzene sulfonic acid						50	146			
46	4-Methoxy-3-nitrobenzene sulfonic acid						66	146 3			
47	3-Chlorobenzene sulfonic acid			199 200	206 7			148			
48	2,5-Dimethylbenzene sulfonic acid		184				24 6	148			
49	Naphthalene-1-sulfonic acid	90	137	181	183	237	68 (66)	150	112 (152)		
50	4-Ethoxybenzene sulfonic acid						39	150			
51	4,6-Dichloro-2,5-dimethylbenzene sulfonic acid						81	150	175		
52	3-Bromo-4-methylbenzene sulfonic acid						60	151			
53	Benzene sulfonic acid	66	148	205	240	176	14 5	153 (156)	112 (110)	170 1	N-Xanthylsulfonamide, 200 N-Benzoyl deriv of amide, 198, Hydrochloride, 201
54	2-Aminobenzene sulfonic acid (Orthanic acid)		132					153			
55	2-Iodonaphthalene-1-sulfonic acid						110	154			
56	2,6-Dichloro-4-methylbenzene sulfonic acid						56	154-5			
57	2-Chloro-5-methylbenzene sulfonic acid						56	156	229 30 5		
58	2-Toluene sulfonic acid (2-Methylbenzene sulfonic acid)	57	170	203 4	218		10	156 3	136, aq al		Sulfonyl bromide, b p 138 <sup>10</sup> , N-Xanthylsulfonamide, 182 3 5

\*Derivative data given in order m p crystal color, solvent from which crystallized

TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS

a) Listed in order of increasing m. p. of the corresponding sulfonamide\* (Continued)

No	Name	Melting point, °C	S Benzylthiuronium salt	p-Toluidinium salt	Anilinium salt	o-Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonamide	Sulfonamide	Miscellaneous
59	3-Bromocamphor-10-sulfonic acid	47.5					65	156.5			
60	2,4-Dinitrobenzene sulfonic acid	106.8 (hyd)					102	157 (154)			Hydrazide, 110
61	2-Methyl-4-nitrobenzene sulfonic acid	130 (anh)				177	106	157			
62	Benzophenone-3,3'-disulfonic acid						di 137.8	di 157	di 177.8		Methylamide, 106.7, Dimethylamide, 118.9
63	3-Nitrobenzyl sulfonic acid	74					100, bz	159, w			
64	4,6-Dimethyl-2-hydroxy-1,3-benzene disulfonic acid						di 89.91	di 160.1			
65	2-Nitrodiphenylamine-4-sulfonic acid	220 d					157	162			
66	2-Ethoxybenzene sulfonic acid						65.6	163	158		Phenylhydrazide, 132.3
67	3-Methyl-2-nitrobenzene sulfonic acid						58.5	163.5			
68	3-Amino-6-methylbenzene sulfonic acid							164	146.7		Chloride of N-acetyl deriv., 124. Chloride of N-chloroacetyl deriv., 87. Amide of N-acetyl deriv., 242.
69	4-Chloro-2-nitrobenzene sulfonic acid						75	164	138		Anhydride, 114.5, Phenylhydrazide, 151, Ph ester, 82, N-Acetyl, 214, Me ester, 92.
70	4-Aminobenzene sulfonic acid (Sulfanilic acid)		185	109		132		165	200	196	
71	3,6-Dichloro-2,5-dimethylbenzene sulfonic acid						71	165	171		
72	6-Aminonaphthalene-1-sulfonic acid		172.4					165			Benzoylguanidine salt, 210.11
73	4-Bromobenzene sulfonic acid	102.3 (88.9)	170	215.6	237.8	182.3	76, eth	166 (161)	119	183.4	
74	5-Bromo-2-methylbenzene sulfonic acid						33.5	167			
75	2,3-Dimethylbenzene sulfonic acid						47	167			
76	5-Chloro-2-methyl-3-nitrobenzene sulfonic acid						60	167			
77	3-Nitrobenzene sulfonic acid	48	146	222	222	193	64	167	126	166.7	
79	4,6-Dichloro-2-methylbenzene sulfonic acid						43	168			
80	4-Chloronaphthalene-2-sulfonic acid						106	168			Et ester, 76.9
81	4-Bromo-2-methylbenzene sulfonic acid						50	168			
82	Propane-1,3-disulfonic acid	92, d without melting					di 45	di 169, w	di 129		B p 157 <sup>1</sup> , Di-toluidide, 222, Dihydrazide, 105
83	Propane-1,1-disulfonic acid							di 169.70	151.2, al		Di-(N-ethyl)anilide, 128.9, al
84	3-Carboxybenzene sulfonic acid (3-Sulfobenzoic acid)	98 (hyd)	163		224.6		di 20	di 170			
85	4-Methyl-2-nitrobenzene sulfonic acid	141 (anh)					98.9	170			o-Aniside, 135
86	2,4-Dimethyl-3-nitrobenzene sulfonic acid	144 (anh)					96	172			

\*Derivative data given in order m. p., crystal color, solvent from which crystallized

TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS  
a) Listed in order of increasing m.p. of the corresponding sulfonamide\* (Continued)

No	Name	Melting point, °C	S-Benzylthiuronium salt	p-Toluidinium salt	Ammonium salt	o-Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonamide	Sulfonamide	Miscellaneous
87	2,5-Dimethyl-3-nitrobenzene sulfonic acid	128		135-6		126 5-7 5	60 1	172 3	143 4		
88	4-Nitrodiphenylamine-2-sulfonic acid						102-4	173	164		
90	3,4-Dibromobenzene sulfonic acid	66 5 7 5 (anh)					34	175			
91	4-Chloro-3-nitrobenzene sulfonic acid						40 1	175-6, yel, al	176		
92	3-Amino-4-methylbenzene sulfonic acid										N-Acetyl of Chloride, 144, N-Benzoyl of Chloride, 196, N-Benzoyl, 203 Me ester, 89, Et ester, 65
93	7-Chloronaphthalene-2-sulfonic acid	118 (anh), 68 (tetrahyd)					86 5	176			
94	4-Bromo-3-nitrobenzene sulfonic acid						55 7	176 7			
95	4-Hydroxybenzene sulfonic acid		169	202	170	192		176-7	141		
96	5-Methylnaphthalene-1-sulfonic acid	115						176-8			
97	4-Methylnaphthalene-1-sulfonic acid						81	177	158		
98	4-Nitrobenzene sulfonic acid	95 (109 11), hyg		179 80			80, lgr	180, 50% al	136 (171), al		
99	3-Chloro-2-methylbenzene sulfonic acid	60 72, 72 (anh)					72, pet eth	180, w			
100	2,5-Dichlorobenzene sulfonic acid	93 7 (> 100)	170	247-8	262 3	250-1	38	181 (186)	160	160	
101	2,4,5-Trimethylbenzene sulfonic acid	112					61 2	181			
102	8-Aminonaphthalene-2-sulfonic acid							181	146 7		N-Acetyl deriv of amide, 213, Benzoylguanidine salt, 214-6
103	5-Chloro-4-methyl-2-nitrobenzene sulfonic acid	128					99	181			
104	2,4-Dichlorobenzene sulfonic acid	86		204-6		170-2	55	182			
105	4-Iodobenzene sulfonic acid						85	183	143		
106	Quinoline-8-sulfonic acid	312					124	183 4			Picrate of Na salt, 226 7, Me ester, 96, Et ester, 73 Me ester, 89, Et ester, 79, Sulfonyl bromide, 124
107	6-Chloronaphthalene-2-sulfonic acid						110 5	183-4			
108	5-Nitronaphthalene-2-sulfonic acid	118-9, yel			260		125	184, yel			
109	4-Chloro-2-methylbenzene sulfonic acid						54	185			
110	4-Chloro-2,5-dimethylbenzene sulfonic acid	100					50	185	155		

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS

a) Listed in order of increasing m.p. of the corresponding sulfonamide\* (Continued)

No	Name	Melting point, °C	S-Benzylthiuronium salt	p Tolu-dinium salt	Am-linium salt	o Tolu-dinium salt	Sulfonyl chloride	Sulfon-amide	Sulfon-anilide	Sulfon-1-naph-thylamide	Miscellaneous
111	2-Carboxy-5-methylbenzene sulfonic acid	190 (158), (anh)					di 59	185			Nitrile of the sulfonyl chloride, 67, lgr, NH <sub>4</sub> salt of 2-amide, 186 (monohyd)
112	8-Chloronaphthalene-2-sulfonic acid						94	185-6			Et ester, 92
113	2-Chloro-5-nitrobenzene sulfonic acid	168-9 d (hyd)					89-90, w	185 6, w			
114	2-Bromobenzene sulfonic acid						51, eth	186, w			
115	2,3-Dichloro-6-methylbenzene sulfonic acid						49	186			
116	2-Methyl-5-nitrobenzene sulfonic acid	133 5 (di-hyd)		256 7		256-8	46 7	186	148		
117	2-Chloro-4-methylbenzene sulfonic acid						46 (52)	186			
118	3,5-Dichloro-2-methylbenzene sulfonic acid						54	186			
119	6-Chloro-3-nitrobenzene sulfonic acid	168 9					90, eth	186, w			
120	2,4-Dimethyl-5-nitrobenzene sulfonic acid	132 (122), dil HNO <sub>3</sub>					98	187 (179)			Sulfonyl fluoride, 109-10
121	2-Methyl-5-nitrobenzene sulfonic acid	131					46 7 (44), eth-pet eth	187	148		
122	4-Chloronaphthalene-1-sulfonic acid	130 3 d			145-6	151	95	187	145-6	162	Me ester, 83, Et ester, 104
123	8-Iodonaphthalene-1-sulfonic acid						115	187	140		
124	2,4-Diaminobenzene-1,5-disulfonic acid						275	187	236		
125	2,6-Dichloro-3-methylbenzene sulfonic acid						19 5	188			
126	4-Nitronaphthalene-1-sulfonic acid						99	188			
127	2-Chlorobenzene sulfonic acid						28 5, eth	188			
128	5-Methylnaphthalene-2-sulfonic acid						120-2	188 9	248-50		
129	Phenanthrene-3-sulfonic acid	175 6 (anh), 120-1 (monohyd), 88-9 (di-hyd)		222			110-1 (108)	190			Me ester, 119-20, al, Et ester, 107 8
130	2,4-Dibromobenzene sulfonic acid	110 (anh)					79, eth	190			
131	8-Nitronaphthalene-1-sulfonic acid	115 (tri-hyd)					165 d	190 5-1 5	178-8 5		
132	4-Methylbenzene-2,4-disulfonic acid	oil		277 d	di 189	170-1	54 (56), eth	di 190 5-1	189		
133	3,5-Dichloro-4-methylbenzene sulfonic acid						69	191			
134	2,5-Dimethyl-6-nitrobenzene sulfonic acid	145 (anh)		158 5-9, al		143-5, 50% al	110, eth-pet-eth	192, 50% al	182, bl, al		

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS**

**a) Listed in order of increasing m.p. of the corresponding sulfonamide\* (Continued)**

No	Name	Melting point, °C	S-Benzylthiuronium salt	p-Toluidinium salt	Anilinium salt	o-Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonanilide	Sulfon-1 naphthylamide	Miscellaneous
135	Quinoline-6-sulfonic acid	> 260					91	192			
136	3,4-Dicarboxybenzene sulfonic acid (4-sulphthalic acid)	138-40 ( <i>monohyd</i> )					167-70 d, eth	192-200 d, w			
137	2-Nitrobenzene sulfonic acid	70 (85)					69	193	115		
138	Phenanthrene-9-sulfonic acid	174 ( <i>anh</i> ) 134 ( <i>hyd</i> )		235			127	193 4, al			Me ester, 106, me al, Et ester, 108, al
139	2-Carboxybenzene sulfonic acid (2-Sulfobenzoic acid)	68 9 ( <i>hyd</i> ), 134 ( <i>anh</i> )	206	197 (200)	165	127-8	79, pet eth, 40, eth	C 193-4 ( <i>anh</i> ), S 153 4, sl htng 195	194 5		
140	4-Bromonaphthalene-1-sulfonic acid						87				
141	2,5-Dibromobenzene sulfonic acid	128 ( <i>anh</i> )					71, pet eth-eth	195, al			
142	7-Methylnaphthalene-1-sulfonic acid						96	195-6	162 4		
143	5-Fluoronaphthalene-1-sulfonic acid	105 6					122-3	196-7			Me ester, 118, eth
144	Acenaphthene-3-sulfonic acid				284 6		113-4	196-9			Me ester, 122-3, Et ester, 137-9, lgr
145	2,5-Dimethyl-4-nitrobenzene sulfonic acid	140		143 5 4 5		143 5 4 5	75	197-8	131		
146	8-Chloronaphthalene-1-sulfonic acid						101 (96 8)	197 6			Me ester, 70, Et ester, 67-8
147	4-Chloro-3-methyl-5-nitrobenzene sulfonic acid						52	201			
148	5-Amino-2-hydroxybenzene sulfonic acid (4-Aminophenol-2-sulfonic acid)	100 ( <i>anh</i> )						202	159		Pyridine salt of O,N-diacetyl deriv, 143-4
149	4-Nitrobenzyl sulfonic acid	71					90	204	220		
150	Anthracene-1-sulfonic acid						90	205			
151	6-Methylnaphthalene-2-sulfonic acid						97 8	205 6			
152	4-Iodonaphthalene-1-sulfonic acid						124 (121)	206 (204)	136		
153	4-Fluoronaphthalene-1-sulfonic acid	100					86, chl	206	144		Et ester, 93
154	4-Aminonaphthalene-1-sulfonic acid (Naphthionic acid)		195					206			N-Acetyl deriv of amide, 241 N-Acetyl deriv of anilide, 231
155	4-Amino-2-nitrobenzene sulfonic acid						59-60	206 7			
156	Retene-6-sulfonic acid	121-3					146-7 5	206 7 5			Me ester, 117 9, Et ester, 114 5
157	2,6-Dimethyl-4-hydroxybenzene-1,3-disulfonic acid						119	208	207		
158	4-(N-methylamino)benzene sulfonic acid	244 5 d						210-1			N-4-Toluenesulfonyl, benzidine salt, 255
159	6-Chloronaphthalene-1-sulfonic acid						70	214			Et ester, 114-5
160	1-Nitronaphthalene-2-sulfonic acid	105, grn			(202)		120-1, pink, bz-pet eth	214, 50% al	202		
161	2,5-Dichlorobenzene-1,3-disulfonic acid						114	215-7			

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS**  
**a) Listed in order of increasing m.p. of the corresponding sulfonamide\* (Continued)**

No	Name	Melting point, °C	S-Benzylthiuronium salt	p-Toluidinium salt	Anilinium salt	o-Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonamide	Sulfonamide	Sulfonamide	Miscellaneous
162	5-Methylbenzene-1,3-disulfonic acid						94, eth	216, w	153, al			
163	Naphthalene-2-sulfonic acid	91, hyg	190 l	221	269	213	76 (79)	217 (213)	132			
164	4-Acetamidobenzene-1-sulfonic acid							218		215		
165	5-Aminonaphthalene-2-sulfonic acid		191					218 9 d	127-8			N-Acetyl, 238-9
166	8-Nitronaphthalene-2-sulfonic acid	135-6 (hyd)					169	223, 228	172-3			
167	5-Chlorobenzene-1,3-disulfonic acid						106	224				
168	2-Methylbenzene-1,4-disulfonic acid						98, bz - pet eth	di 224	di 178			
169	4-Carboxy-3-nitrobenzene sulfonic acid	111 (+ 2½-H <sub>2</sub> O)					di 160	di 226, mono-S	192			
170	5-Chloronaphthalene-1-sulfonic acid						95	226	138			Me ester, 89, Et ester, 46 Sulfonyl bromide, 110
171	3,4-Di-iodobenzene sulfonic acid	122 5, after drying at 100					82, bz - pet eth	227, aq al				Me ester, 93, al, Et ester, 82 5, al
172	2,4,6-Tribromobenzene sulfonic acid	64					64	228	220-2			
173	4'-Nitrobiphenyl-4-sulfonic acid						178	228				
174	3,4-Dichloro-2-methylbenzene sulfonic acid						52	228				
175	Benzene-1,3-disulfonic acid		214				63	229	148 50	245		Alkali fusion → resorcinol, 110
176	Biphenyl-4-sulfonic acid						115	230	125			
177	2,4-Di-iodobenzene sulfonic acid	162 (anh)					77 8	230				Me ester, 78, al, Et ester, 57, al
178	1-Ethoxybenzene-2,5-disulfonic acid						di 106-8	di 233				
179	Methane disulfonic acid (Methionic acid)						8, b p 133 <sup>10</sup>	di 233	di 192-3			B p 220-70 <sup>10-15</sup> d
180	3,5-Dinitrobenzene sulfonic acid						99, chl - lgr	235, w, al				
181	4-Aminobenzene-1,3-disulfonic acid (Aniline-2,4-disulfonic acid)	120 d						di 235				
182	5-Iodonaphthalene-1-sulfonic acid						114	236 (239)				
183	5-Nitronaphthalene-1-sulfonic acid				265		113	236	123			Me ester, 117 8, chl
184	4-Carboxybenzene sulfonic acid (4-Sulfobenzoic acid)	94 (hyd), 260 (anh)	213					di 57	di 236	di 252		
185	2,3-Dichloro-4-methylbenzene sulfonic acid						41	237				
186	6-Hydroxynaphthalene-2-sulfonic acid	167 (anh), 129 (hyd)	217 (207)	248	264	208		237	161			
188	4-Methylbenzene-1,2-disulfonic acid						109-11, bz - pet eth	237 9	190, al			

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS**  
**a) Listed in order of increasing m.p. of the corresponding sulfonamide\* (Continued)**

No	Name	Melting point °C	S-Benzylthiuronium salt	<i>o</i> -Toluidinium salt	Anilinium salt	<i>p</i> -Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonamide	Sulfon-1 naphthylamide	Miscellaneous
189	4,5-Dimethylbenzene-1,3-disulfonic acid						79, yel, al	239	200, al		
190	4-Hydroxybenzene-1,3-disulfonic acid (Phenol-2,4-disulfonic acid)	> 100 d					<i>di</i> 89	<i>di</i> 239	<i>di</i> 205		
191	4-Methoxybenzene-1,3-disulfonic acid						86	240	209		
192	4-Acetamidonaphthalene-1-sulfonic acid (Acetylnaphthionic acid)			232 3	231 2			241	231		
193	Naphthalene-2,7-disulfonic acid		212	299	251-2	238	158 (162), bz	242			
194	5-Nitrobenzene-1,3-disulfonic acid						<i>di</i> 97 8	<i>di</i> 242			
195	2,4,6-Trimethylbenzene-1,3-disulfonic acid (Mesitylene disulfonic acid)						<i>di</i> 125	<i>di</i> 244	<i>di</i> 150-1		
196	2,3,4,6-Tetrabromobenzene sulfonic acid						96 5	<i>ca</i> 245 d			
197	4,6-Dimethylbenzene-1,3-disulfonic acid						130, pet eth	249, w	196, 50° al		
198	1-Chloronaphthalene-2-sulfonic acid	130 3 d ( <i>anh</i> )					84-5	250	171 2		Et ester, 104
199	Azobenzene-4,4'-disulfonic acid	169 d ( <i>anh</i> )					<i>di</i> 222 (170)	<i>di</i> 250 d			
200	Phenanthrene-2-sulfonic acid	150		291			156, ac a	253-4, al	157 8		Me ester, 101-2 (96-8), Et ester, 89, yel br, al Imide, 186
201	Benzene-1,2-disulfonic acid		206				143	254	241		
202	2-Amino-5-methylbenzene-1,4-disulfonic acid	d at 290					<i>di</i> 156, chl	<i>di</i> 257, w	<i>di</i> 196-7, aq al		
203	5-Aminonaphthalene-1-sulfonic acid (Laurent's acid)		179					259-60	171		N-Acetyl deriv of aniline salt, 344
204	2-Methylbenzene-1,3-disulfonic acid						88, bz	> 260	162, al		
205	Anthracene-2-sulfonic acid						122, yel, tol	261	201		Me ester, 157, yel, Et ester, 160, Phenylhydrazide, 210
206	Anthraquinone-2-sulfonic acid		211	308	309		197, pa yel, bz	261, yel, ac a	193, yel-br		Me ester, 123, Et ester, 125
207	7-Nitronaphthalene-1-sulfonic acid						169 70	261 2			
208	Azoxybenzene-3,3-disulfonic acid	126					138	273			
209	Naphthalene-1,4-disulfonic acid						160 (166)	273, w, al	179		
210	4,6-Dichlorobenzene-1,3-disulfonic acid						123	276			
211	Benzidine-2,2'-disulfonic acid						Hydrochloride, 205	278			
212	9,10-Dichloroanthracene-2-sulfonic acid						221	279	248		
213	4-Nitronaphthalene-2,7-disulfonic acid						<i>di</i> 140 l	<i>di</i> 286-7			
214	Benzene-1,4-disulfonic acid						131 (139)	288	249		
215	Azobenzene-3,4'-disulfonic acid						<i>di</i> 123 5	<i>di</i> 288			
216	Naphthalene-1,3-disulfonic acid						<i>di</i> 137 5	<i>di</i> 292 3			
217	2,5-Dimethylbenzene-1,3-disulfonic acid						81, lgr	295, al	174, al		
218	Naphthalene-1,6-disulfonic acid	125 ( <i>anh</i> )	81	314-5	298-9	323 4	129, bz	297-8			

\*Derivative data given in order m p, crystal color, solvent from which crystallized



TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS

a) Listed in order of increasing m.p. of the corresponding sulfonamide\* (Continued)

No	Name	Melting point °C	S-Benzyl thiuronium salt	p Toluendinium salt	Anilinium salt	o Toluendinium salt	Sulfonyl chloride	Sulfonamide	Sulfonamide	Sulfonamide	Miscellaneous
219	Naphthalene-1,7-disulfonic acid						<i>di</i> 123	<i>di</i> 298 300			
220	Biphenyl-4,4'-disulfonic acid	72	171	330			203	300			
221	Naphthalene-2,6-disulfonic acid		256				225, bz	305			
222	Azobenzene-3,3'-disulfonic acid						166	305			
223	Naphthalene-1,5-disulfonic acid	240 5 ( <i>anh</i> )	257 (251)				<i>di</i> 183	<i>di</i> 310 (>340)	<i>di</i> 249		Di-Me ester, 205, chl
224	Benzene-1,3,5-trisulfonic acid	>100					<i>tri</i> 187	<i>tri</i> 310 5	<i>tri</i> 237		Tri-Et ester, 147, bz
225	Anthracene-1,5-disulfonic acid						<i>di</i> 249, pa yel	<i>di</i> >330, yel	<i>di</i> 293		
226	Anthracene-1,8-disulfonic acid						225 yel, bz	333	224		
227	Anthraquinone-1,8-disulfonic acid	293 4					222 3, yel PhNO <sub>2</sub>	>340	237 8, yel, PhNO <sub>2</sub>		
228	Anthraquinone-1,5-disulfonic acid	310-1 ( <i>hyd</i> ), yel					265-70, yel, PhNO <sub>2</sub>	>350	269 70, red-yel, PhNO <sub>2</sub>		

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS

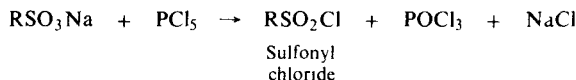
b) M.p. of the amide deriv. not available; listed in order of increasing m.p. of the corresponding anilide deriv.\*

No	Name	Melting point, °C	S-Benzylthiuronium salt	p-Toluidinium salt	Anilinium salt	o-Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfon anilide	Sulfon-1-naphthylamide	Miscellaneous
1	Ethane-1,2-disulfonic acid	104	201 2	270 d	270, w		dt 95		69		m-Toluidide, 230, Di-Et ester, 77, eth
2	Vinylsulfonic acid (Ethylene-sulfonic acid)		145 6, w				b p 118 20 <sup>250</sup>		71, b p 174 <sup>1</sup>		B p 135 <sup>2</sup> , n <sub>D</sub> <sup>20</sup> 1 4505
3	Phenol-O-sulfonic acid	145 (hyd)		124-5	165				126 5-7 5		
4	8-Aminonaphthalene-1-sulfonic acid (Peri acid)		300						139 40		Anilinium salt of N-acetyl deriv., 273
5	3,5-Dimethyl-2-hydroxybenzene sulfonic acid	121 5 d							142 3		Chloride of O-acetyl deriv., 62, pet eth, Methylanilide, 111 2
6	Benzophenone-2-sulfonic acid						96-7		143 5		
7	7-Hydroxynaphthalene-1,3,6-trisulfonic acid						196		152-5		
8	1-Hydroxynaphthalene-2-sulfonic acid	> 250	169						O-acetyl deriv., 157-8		O-acetyl deriv of p-toluidide, 135-6
9	2-Hydroxynaphthalene-1,6-disulfonic acid						dt 111		dt 191		
10	Anthraquinone-2,7-disulfonic acid						dt 186, chl		dt 192		
12	7-Hydroxynaphthalene-1,3-disulfonic acid (G-Acid)		228	294		271	eth 161-2		195		
13	7-Hydroxynaphthalene-1-sulfonic acid (Bayer Acid)		218	232	240	242			195		
14	4-Hydroxynaphthalene-1-sulfonic acid (NW-Acid)	170, r h	103	196	186 7	203-4			199-200		2-Naphthylamide, 204
15	5-Hydroxynaphthalene-1-sulfonic acid	110-2 d							201		Chloride of O-acetyl deriv., 129
16	2-Hydroxynaphthalene-3,6-disulfonic acid (R-Acid)		233	250	254	257			202		
17	Anthraquinone-1-sulfonic acid	218	191		284		216 8, yel, PhNO <sub>2</sub>		214, gold-yel		NH <sub>3</sub> → 1-Aminoanthraquinone, 252 (243)
18	Anthraquinone-1,6-disulfonic acid	215 7, gold, ac a					197 8, yel, PhNO <sub>2</sub>		227 8, yel, cl -bz		
19	2-Hydroxynaphthalene-1,5-disulfonic acid						dt 177		dt 231		
20	2-Hydroxynaphthalene-1,7-disulfonic acid			219			169		233		
21	Anthraquinone-1,7-disulfonic acid	120 (hyd)					231-2, br -yel, PhNO <sub>2</sub>		237 8, yel, cl -bz		
22	Anthraquinone-2,6-disulfonic acid						dt 250, yel, cl -bz		dt 321		

\*Derivative data given in order m p, crystal color, solvent from which crystallized

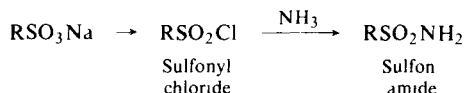
## EXPLANATIONS AND REFERENCES TO TABLES XXII AND XXIII

The main derivatives of the sulfonic acids are obtained by converting them to the corresponding sulfonyl chlorides. Hence sulfonic acids and sulfonyl chlorides are often identified through the same derivatives.

*Sulfonyl chloride*

From the sulfonic acid or its sodium or potassium salt with phosphorus pentachloride without solvent

*For directions and examples see* Cheronis, p 638, Linstead, p 89, Shriner, pp 268, 270, Vogel, p 553, Wild, p 161

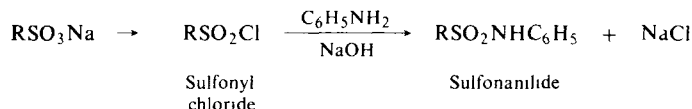
*Sulfonamide \**

From the sulfonyl chloride (prepared from the acid or its salt) and concentrated aqueous ammonia solution

*For directions and examples see* Linstead, p 49, Shriner, pp 268, 270, Vogel, p 553, Wild, p 161

From the sulfonyl chloride, aqueous ammonia and ammonium carbonate

*See* Cheronis, p 639

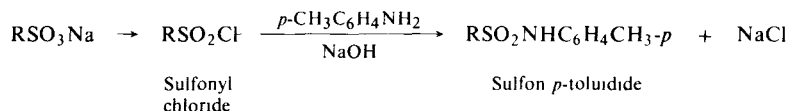
*Sulfonanilide \**

From the sulfonyl chloride (prepared from the acid), aniline, and sodium hydroxide

*For directions and examples see* Linstead, p 89, Wild, p 161

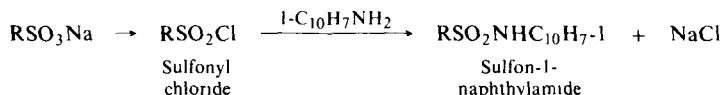
From the sulfonyl chloride and aniline

*See* Vogel, p 553

*Sulfon-p-toluidide \**

From the sulfonyl chloride, *p*-toluidine and aqueous sodium hydroxide

*For directions and examples see* Vogel, p 553

*Sulfon-1-naphthylamide \**

From the sulfonyl chloride (prepared from the acid) and 1-naphthylamine in benzene

*For directions and examples see* Cheronis, p 639

*S-Benzylthiuronium salt \**

From the sodium, potassium or ammonium salt of the sulfonic acid and S-benzylthiuronium chloride in water

*For directions and examples see* Cheronis, pp 635, 636, Linstead, pp 15, 89, Shriner, p 269, Wild, pp 149, 159, E. Chambers and G. W. Watt, *J Org Chem*, **6**, 376 (1941), E. Campaigne and C. M. Suter, *J Amer Chem Soc*, **64**, 3040 (1942), S. Veibel, *J Amer Chem Soc*, **67**, 1867 (1945)

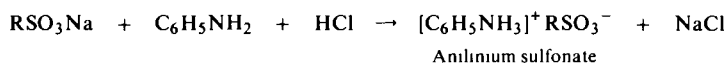
**\*Derivatives recommended for first trial**

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives.

## EXPLANATIONS AND REFERENCES TO TABLE XXII AND XXIII (Continued)

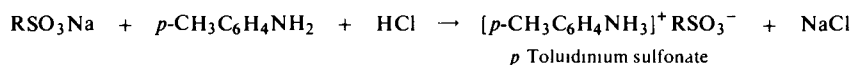
From sodium or potassium sulfonate and S-benzylthiuronium chloride in alcohol  
See J J Donleavy, *J Amer Chem Soc*, **58**, 1004 (1936)

### Anilinium salt \*



From the sodium or potassium salt of the acid, aniline and hydrochloric acid in water  
For directions and examples see Cheronis, p 637, O C Dermer and V H Dermer, *J Org Chem*, **7**, 581 (1942)

### *p*-Toluidinium salt \*



From the sulfonic acid and *p*-toluidine

For directions and examples see Shriner, p 269

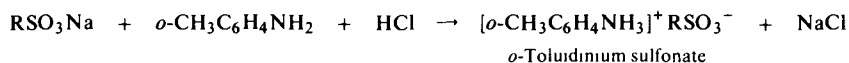
From the sodium, potassium or ammonium salt with *p*-toluidine or *p*-toluidine hydrochloride in water

See Shriner, p 269, Vogel, p 555, O C Dermer and V H Dermer, *J Org Chem*, **7**, 581 (1942), A D Barton and L Young, *J Amer Chem Soc*, **65**, 294 (1943)

From the sodium, potassium, ferric or barium salt (after boiling with sulfuric acid) with *p*-toluidine and hydrochloric acid

See Cheronis, p 637, Fieser, *J Amer Chem Soc*, **51**, 2460 (1929)

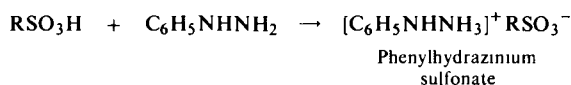
### *o*-Toluidinium salt \*



From the sodium or the potassium salt of the sulfonic acid with *o*-toluidine and hydrochloric acid in water

For directions and examples see Cheronis, p 637, O C Dermer and V H Dermer, *J Org Chem*, **7**, 581 (1942)

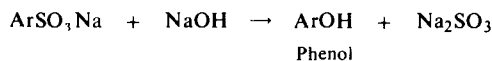
### Phenylhydrazinium salt \*



From the sulfonic acid with phenylhydrazine in water-alcohol

For directions and examples see Wild, p 159, P H Latimer and R W Bost, *J Amer Chem Soc*, **59**, 2500 (1937)

### Phenols by KOH fusion



By fusion of the sodium arylsulfonate and sodium hydroxide in a nickel crucible

For directions and examples see Vogel, p 552

By fusion of the sodium arylsulfonate, potassium hydroxide and zinc dust

See Linstead, p 89

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES  
(Listed in order of increasing m.p.)\*

No	Name	Melting point °C	Sulfonic acid	Amide	Amide	l Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S Benzylthiuronium	p-Toluidine	Aniline	o-Toluidine	
1	Methanedisulfonyl chloride	8	b p 220 70 <sup>15</sup> , 20 <sup>d</sup>	233	192-3						B p 133 <sup>10</sup>
2	2-Ethylbenzenesulfonyl chloride	11 7		100							
3	3-Methylbenzenesulfonyl chloride (Toluene-3-sulfonyl chloride)	12		108, al	96						
4	4-Ethylbenzenesulfonyl chloride	12		110							N-Xanthylsulfonamide 196
5	Benzenesulfonyl chloride	14 5	43 4 (mono-hyd) 66 (anh)	156, 153		170 1	148	205	240	176	N-Xanthylsulfonamide, 200
6	Heptane-1-sulfonyl chloride	16		75							
7	2,6-Dichloro-3-methylbenzenesulfonyl chloride	19 5		188							
8	3-Carboxybenzenesulfonyl chloride	20	98 (hyd), 148 (anh)	di 170			163	224 6			The m p is that of the 1,3-dichloride
9	3,4-Dichlorobenzenesulfonyl chloride	22 4 19		140 135							
10	5-Chloro-2-methylbenzenesulfonyl chloride	24		145, aq al							
11	2,5-Dimethylbenzenesulfonyl chloride	24 6	48 (anh) 86 (hyd)	148			184				N-Xanthylsulfonamide, 176
12	2-Chlorobenzenesulfonyl chloride	28 5		188							
13	2-Phenylethane-1-sulfonyl chloride	33	91	122	77						
14	5-Bromo-2-methylbenzenesulfonyl chloride	33 5		166 7							
15	2,4-Dimethylbenzenesulfonyl chloride	34	62 (hyd)	110							
16	3,4-Dibromobenzenesulfonyl chloride	34	66 5 7 5 (anh)	175							
17	2,4,6-Trichlorobenzenesulfonyl chloride	35 40		210 2d							
18	4-Methyl-3-nitrobenzenesulfonyl chloride	36	92, hyg	144 5	109	153		130-1		28	
19	4-Fluorobenzenesulfonyl chloride	36, 30		125							
20	3-Ethoxybenzenesulfonyl chloride	38		131							
21	3-Chloro-4-methylbenzenesulfonyl chloride	38		134	96						
22	2,5-Dichlorobenzenesulfonyl chloride	38	93-7	181	160	160	170	247-8	262 3	250 1	
23	2,6-Dimethylbenzenesulfonyl chloride	39	98	113 96							
24	4-Ethoxybenzenesulfonyl chloride	39		150							
25	4-Chloro-3-nitrobenzenesulfonyl chloride	40 1 60-2		175 6 yel al							
26	2,3-Dichloro-4-methylbenzenesulfonyl chloride	41		237							
27	4,6-Dichloro-2-methylbenzenesulfonyl chloride	43		168							
28	3,3-Dimethylbutane-1-sulfonyl chloride	43 4		96 7							
29	Propane-1,3-disulfonyl chloride	45	92d	169, w	di 125						Di-m-toluidide 222
30	2-Chloro-4-methylbenzenesulfonyl chloride	46, 52		186							
31	Indane-5-sulfonyl chloride	46-7, eth	92	135 5-6, al	129, al						
32	2-Methyl-5-nitrobenzenesulfonyl chloride	46-7	133 5 (+2H <sub>2</sub> O)	186	148			256-7		256-8	B p 183 5 <sup>10</sup>
33	2,3-Dimethylbenzenesulfonyl chloride	47		167							

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1-Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S Benzylthionium	p-Toluidine	Aniline	o-Toluidine	
34	4-Bromo-3-methylbenzenesulfonyl chloride	50		146							
35	3-Methyl-4-nitrobenzenesulfonyl chloride	50		133 5							
36	4-Bromo-2-methylbenzenesulfonyl chloride	50		168							
37	4-Chloro-2,5-dimethylbenzenesulfonyl chloride	50	100	185	155						
38	2-Bromobenzenesulfonyl chloride	51, eth		186 w							
39	3,4-Dichloro-2-methylbenzenesulfonyl chloride	51 2		228							
40	3,4-Dimethylbenzenesulfonyl chloride	52	64 55	144			208				
41	4-Chloro-3-methyl-5-nitrobenzenesulfonyl chloride	52		201							
42	4-Chlorobenzenesulfonyl chloride	53	69 93	144	104	190	175	208-10	222 3	163 4	
43	Indane-4-sulfonyl chloride	53 3 5		118 9, w							B p 140 1
44	4-Methylbenzene-1,3-disulfonyl chloride (Toluene-2,4-disulfonyl chloride)	54 46		186 7 191	189						
45	4-Chloro-2-methylbenzenesulfonyl chloride	54		185							
46	3,5-Dichloro-2-methylbenzenesulfonyl chloride	54		186							
47	Hexadecane-1-sulfonyl chloride	54	54	97							
48	2,4-Dichlorobenzenesulfonyl chloride	55	86	182				204 6		170-2	
49	4-Bromo-3-nitrobenzenesulfonyl chloride	55 7		176 7							
50	2,4,6-Trimethylbenzenesulfonyl chloride	56	78	142	109						
51	2-Chloro-5-methylbenzenesulfonyl chloride	56		156	229 30 5						
52	2,6-Dichloro-4-methylbenzenesulfonyl chloride	56		154 5							
53	4-Carboxybenzenesulfonyl chloride	57	94 (hyd ), 260 (anh )	di 236	di 252						The m p is that of the 1,4-dichloride
54	Tetraai-6-sulfonyl chloride	58		135	155 6						
55	3-Methyl-2-nitrobenzenesulfonyl chloride	58 5		163 5							
56	5-Carboxy-2-methylbenzenesulfonyl chloride (4-Toluic acid-2-sulfonyl chloride)	59	190, 158 (anh )	185							The m p is that of the 1,5-dichloride
57	4-Amino-3-nitrobenzenesulfonyl chloride (2-Nitroaniline-4-sulfonyl chloride)	59-60		206-7							
58	5-Chloro-2-methyl-3-nitrobenzenesulfonyl chloride	60		167							
59	3-Bromo-4-methylbenzenesulfonyl chloride	60		151							
60	2,5-Dimethyl-3-nitrobenzenesulfonyl chloride	61	128, 200	173	143 4			136			
61	2,4,5-Trimethylbenzenesulfonyl chloride	61	112	181							
62	Benzene-1,3-disulfonyl chloride	63		229	148 50	245	214				N-Xanthylsulfonamide, 170 Alk fusion → resorcinol, 110
63	4-Chloro-3-methylbenzenesulfonyl chloride	63		128	92						

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1 Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S-Benzylthiuronium	p-Toluidine	Aniline	o-Toluidine	
64	7-Methylnaphthalene-2-sulfonyl chloride	63-4		163-4							
65	2,4,6-Tribromobenzenesulfonyl chloride	64	64	228	220-2d						
66	3-Nitrobenzenesulfonyl chloride	64	48	167	126	166-5	146	222	126-5-7-5	193	
67	2,3,4-Trichlorobenzenesulfonyl chloride	64-5		227-30							
68	3-Bromocamphor-10-sulfonyl chloride	65	47-5	156							
70	2-Ethoxybenzenesulfonyl chloride	65-6		163	158						
71	4-Methoxy-3-nitrobenzenesulfonyl chloride	66		146-3							
72	D-Camphor-10-sulfonyl chloride	67	193	132	121-88						
73	2-Methylbenzenesulfonyl chloride (Toluene-2-sulfonyl chloride)	68	57	156-3	136		170	203-4	218		N-Xanthylsulfonamide, 182-3-5
74	Naphthalene-1-sulfonyl chloride	68, 66	90	150	112-152		137	181	183	237	
75	4-Methylbenzenesulfonyl chloride (Toluene-4-sulfonyl chloride)	69	104-5	138-5-9 (anh), 105 (+2H <sub>2</sub> O)	103	157	181-2	198	238	190	
76	2-Nitrobenzenesulfonyl chloride	69	70-85	193	115						
77	3,5-Dichloro-4-methylbenzenesulfonyl chloride	69		191							
78	2,4-Dimethoxybenzenesulfonyl chloride	70		167							
79	6-Chloronaphthalene-1-sulfonyl chloride	70		214							
80	3,4-Dimethyl-5-nitrobenzenesulfonyl chloride	70		180							
81	2,5-Dibromobenzenesulfonyl chloride	71	128 (anh)	195							
82	3,6-Dichloro-2,5-dimethylbenzenesulfonyl chloride	71		165	171						
83	3-Chloro-2-methylbenzenesulfonyl chloride	72, pet eth	60-72	180, w							
84	4-Methoxynaphthalene-2-sulfonyl chloride	75		157	145						
85	2-Chloronaphthalene-1-sulfonyl chloride	75		153							
86	4-Chloro-2-nitrobenzenesulfonyl chloride	75	82	164, 237	138						Phenylhydrazide 151, Ph ester, 82
87	2,5-Dimethyl-4-nitrobenzenesulfonyl chloride	75	140	197-8	131			143-5-4-5		143-5-4-5	
88	4-Bromobenzenesulfonyl chloride	76, eth	88-90	166, 161	119	183-5	170	215-6	237-8	182-3	
89	Naphthalene-2-sulfonyl chloride	76, 79	91, hyg, 122	217, 213	132		190-1	221	269	213	
90	6-Bromonaphthalene-1-sulfonyl chloride	77		217							
91	2,4-Di-iodobenzenesulfonyl chloride	77-8	167 (anh)	230							Me ester, 78, al, Et ester, 57, al
92	2-Carboxybenzenesulfonyl chloride	79, pet eth	68-9 (hyd), 134 (anh)		194-5		206	196-200	165	127-8	The m p is that of the 1,2-dichloride
93	2,4-Dibromobenzenesulfonyl chloride	79, eth	110 (anh)	190							
94	4,5-Dimethylbenzene-1,3-disulfonyl chloride	79, yel		239	200, al						

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1-Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S Benzylthiuronium	p-Toluidine	Aniline	o-Toluidine	
95	4-Nitrobenzenesulfonyl chloride	80 lgr	109 11 95 hyg	180, 50% al	171 136 d			179 80			
96	6-Methoxynaphthalene-1-sulfonyl chloride	80 5		149 5	177 5						
97	2,5-Dimethylbenzene-1,3-disulfonyl chloride	81, lgr		295 al	174 al						
98	4,6-Dichloro-2,5-dimethylbenzenesulfonyl chloride	81		150	175						
99	4-Methylnaphthalene-1-sulfonyl chloride	81, eth		174 177 al	158						
100	3,4-Di-iodobenzenesulfonyl chloride	82, bz pet eth	122 5	227, aq al							
101	3-Chloro-4-methoxybenzenesulfonyl chloride	82		131							
102	7-Methoxynaphthalene-2-sulfonyl chloride	83		220	121						
103	2-Methylnaphthalene-1-sulfonyl chloride	83 5		124							
104	1-Chloronaphthalene-2-sulfonyl chloride	84 5	130 3d (anh)	250	171 2						
105	4-Iodobenzenesulfonyl chloride	85		183	143						
106	4-Ethoxynaphthalene-2-sulfonyl chloride	85		183	143 5						
107	4,5-Dichloro-3-methylbenzenesulfonyl chloride	85 8		183 5							
108	4-Methoxybenzene-1,3-disulfonyl chloride	86		240	209						
109	4-Fluoronaphthalene-1-sulfonyl chloride	86	100 (hyd)	206	144						Et ester, 93
110	7-Chloronaphthalene-2-sulfonyl chloride	87	68 (tetra- hyd) 118 (anh)	76							Me ester, 89, Et ester, 65
111	4-Bromonaphthalene-1-sulfonyl chloride	87		195							
112	D-Camphor-3-sulfonyl chloride	88	77	143	124			196 7			Me ester, 77
113	2-Methylbenzene-1,3-disulfonyl chloride	88		260	162						
114	8-Methylnaphthalene-2-sulfonyl chloride	88		116							
115	4-Hydroxybenzene-1,3-disulfonyl chloride (Phenol-2,4 disulfonyl chloride)	89	>100d	239							
116	3,5-Dimethyl-2-hydroxybenzene-1,3-disulfonyl chloride	89 91		160 1							
117	Anthracene-1-sulfonyl chloride	90		205							
118	2-Chloro-5-nitrobenzenesulfonyl chloride	90, w	168 9d (hyd)	185 6							
119	Quinoline-6-sulfonyl chloride	91	>260	192							
120	Benzylsulfonyl chloride	92 3, eth, lgr		105, w, al	102	166 146		113, al	102	83	Hydrazide, 131 2, Phenylhydrazide, 173
121	6-Iodonaphthalene-1-sulfonyl chloride	92 5		213							
122	6-Methoxynaphthalene-2-sulfonyl chloride	93		189	120						
123	5-Chloro-2-nitrobenzenesulfonyl chloride	93		159							
124	1-Bromonaphthalene-2-sulfonyl chloride	93		271							

\*Derivative data given in order m p, crystal color solvent from which crystallized



TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1-Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S-Benzylthiuronium	p-Toluidine	Aniline	o-Toluidine	
125	5-Methylbenzene-1,3-disulfonyl chloride	94, eth		216, w	153, al						
126	3,5-Dimethylbenzenesulfonyl chloride	94, 90, bz		135, al	129, al			121 2, al			
127	8-Chloronaphthalene-2-sulfonyl chloride	94		185							
128	1-Iodonaphthalene-2-sulfonyl chloride	94		247							
129	4-Chloronaphthalene-1-sulfonyl chloride	94 5	130 3d	187		162				151	<i>o</i> -Toluidide 145 6 Me ester 83 Et ester, 104 Di-Et ester 77 eth <i>m</i> -Toluidide 230
130	Ethane-1,2-disulfonyl chloride	95		69			201 2	270d	270, w		
131	5-Bromonaphthalene-1-sulfonyl chloride	95		232 3							
132	5-Chloronaphthalene-1-sulfonyl chloride	95		226	138						Sulfonyl bromide, 110, Me ester, 89, Et ester, 46
133	7-Methylnaphthalene-1-sulfonyl chloride	96		195 6	162 4						
134	2,4-Dimethyl-3-nitrobenzenesulfonyl chloride	96	144 (anh)	172							
135	5-Bromonaphthalene-2-sulfonyl chloride	96		220							
136	2-Benzoylbenzenesulfonyl chloride (Benzophenone 2-sulfonyl chloride)	96 7			143 5						
137	2,3,4,6-Tetrabromobenzenesulfonyl chloride	96 5		245d							
138	10-Bromocamphor-3-sulfonyl chloride	97		100 2							
139	6-Fluoronaphthalene-2-sulfonyl chloride	97 chl	105 (hyd)	133	129		190 1	221	269	213	
140	2-Bromonaphthalene-1-sulfonyl chloride	97		140							
141	6-Methylnaphthalene-2-sulfonyl chloride	97 8		205 6							
142	5-Nitrobenzene-1,3-disulfonyl chloride	97 8		242							
143	2,4-Dimethyl-5-nitrobenzenesulfonyl chloride	98	132 122 dil HNO <sub>3</sub>	187 179							Sulfonyl fluoride, 109 10
144	2-Methylbenzene-1,4-disulfonyl chloride	98		224	<i>dt</i> 178						
145	4-Methyl-3-nitrobenzenesulfonyl chloride	98 9		170							<i>o</i> -Anisidide, 135
146	4-Methoxynaphthalene-1-sulfonyl chloride	98 5		226	147 5						
147	5-Chloro-4-methyl-2-nitrobenzenesulfonyl chloride	99	128	181							
148	3,5-Dinitrobenzenesulfonyl chloride	99, chl, lgr		235							
149	4-Nitronaphthalene-1-sulfonyl chloride	99		188							
150	7-Iodonaphthalene-2-sulfonyl chloride	100		210							
151	7-Bromonaphthalene-2-sulfonyl chloride	100		218							

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1-Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S Benzylthiuronium	p Toluene	Aniline	o-Toluene	
152	3-Nitrobenzylsulfonyl chloride	100, bz	74 (hyd)	159 d, w							Me amide 106.7 Dimethylamide 118.9
153	8-Chloronaphthalene-1-sulfonyl chloride	101		197							
154	2,4-Dinitrobenzenesulfonyl chloride	102	106.8 (hyd) 130 (anh)	157 154							Hydrazide, 110
155	4-Nitrodiphenylamine-2-sulfonyl chloride	102.4		173	164						
156	4-Ethoxynaphthalene-1-sulfonyl chloride	103		170	180						
157	7-Ethoxynaphthalene-2-sulfonyl chloride	103		142	153						
158	3,7-Diethylnaphthalene-1-sulfonyl chloride	105.7		207							
159	5,6-Dichloronaphthalene-1-sulfonyl chloride	106		223							
160	4-Chloronaphthalene-2-sulfonyl chloride	106		168							Et ester 76.9
161	2-Methyl-4-nitrobenzenesulfonyl chloride	106		157							
162	DL-Camphor-8-sulfonyl chloride	106	56.8	133.5, w							
163	5-Chlorobenzene-1,3-disulfonyl chloride	106		224							
164	3-Ethoxybenzene-1,4-disulfonyl chloride	106.8		di 233							
165	6-Ethoxynaphthalene-2-sulfonyl chloride	107.5		183	153						
166	4-Methylbenzene-1,2-disulfonyl chloride	109.11		237.9	190						
167	2,5-Dimethyl-6-nitrobenzenesulfonyl chloride	110	145 (anh)	192	182			158.5 9		143.5 50% al	
168	2-Iodonaphthalene-1-sulfonyl chloride	110		154							
169	Phenanthrene-3-sulfonyl chloride	110-1	175.6 (anh) 120.1 (+1 H <sub>2</sub> O) 88d (+2H <sub>2</sub> O)	190			222				Me ester 119.20, al Et ester 107.8
170	6-Chloronaphthalene-2-sulfonyl chloride	110.5		184							
171	2-Hydroxynaphthalene-1,6-disulfonyl chloride	111			di 191						
172	Acenaphthene-5-sulfonyl chloride	111		223	178						
173	3-Hydroxynaphthalene-2-sulfonyl chloride	112		110					241.2		
174	5-Nitronaphthalene-1-sulfonyl chloride	113		236	123						
175	Acenaphthene-3-sulfonyl chloride	113.4	87.9	199	284.6						Me ester, 122.3, Et ester, 137.9, lgr
176	2,5-Dichlorobenzene-1,3-disulfonyl chloride	114		215.7							
177	5-Chloronaphthalene-2-sulfonyl chloride	115		216							
178	Biphenyl-4-sulfonyl chloride (4-Phenylbenzenesulfonyl chloride)	115		230	125						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Amide	Anilide	1-Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S-Benzylthiuronium	p-Toluidine	Aniline	o-Toluidine	
179	2-Ethoxynaphthalene-1-sulfonyl chloride	116		158	187						
180	4,5-Dichloronaphthalene-1-sulfonyl chloride	117		229							
181	2,6-Dimethyl-4-hydroxybenzene-1,3-disulfonyl chloride	117 8		206-8	205 7						
182	6-Ethoxynaphthalene-1-sulfonyl chloride	118		154	194 5						
183	4,6-Dichloronaphthalene-1-sulfonyl chloride	119		226							
184	5-Methoxynaphthalene-1-sulfonyl chloride	119 5		194 5	157						
185	5-Methylnaphthalene-2-sulfonyl chloride	120 2		188 9	248-50, 133-4						
186	8-Bromonaphthalene-2-sulfonyl chloride	121		187							
187	5-Ethoxynaphthalene-1-sulfonyl chloride	121		182 5	130						
188	2-Methoxynaphthalene-1-sulfonyl chloride	121		159	196 5						
189	1-Nitronaphthalene-2-sulfonyl chloride	121, pink, bz-pet eth	105, lgr	214	202						
190	6,8-Dichloronaphthalene-2-sulfonyl chloride	121		228							
191	2-Chloro-5-methyl-6-nitrobenzene sulfonyl chloride	122		177							
192	Anthracene-2-sulfonyl chloride	122		261	201						Me ester, 157, Et ester, 160 Me ester, 118, eth
193	5-Fluoronaphthalene-1-sulfonyl chloride	122-3	105 (hyd)	196 7							
194	4,6-Dichlorobenzene-1,3-disulfonyl chloride	123		276							
195	Azobenzene-3,4'-disulfonyl chloride	123 5		di 288							
196	7,8-Dichloronaphthalene-2-sulfonyl chloride	124		227							
197	4-Iodonaphthalene-1-sulfonyl chloride	124, 121		206, 204	136						
198	6-Bromonaphthalene-2-sulfonyl chloride	124		127							
199	Quinoline-8-sulfonyl chloride	124	312	183-4							Me ester, 96, Et ester, 73
200	4-Methylnaphthalene-2-sulfonyl chloride	124 5		143-4							
201	1,5-Dichloronaphthalene-1-sulfonyl chloride	125		282							
202	2,4,6-Trimethylbenzene-1,3-disulfonyl chloride	125		di 244	di 150 1						
203	5-Nitronaphthalene-2-sulfonyl chloride	125	118-9, yel	184							
204	6-Nitronaphthalene-1-sulfonyl chloride	127		223-4							
205	Phenanthrene-9-sulfonyl chloride	127	174 (anh)	193-4				235			Me ester, 106, me al, Et ester, 108 al
206	Naphthalene-1,6-disulfonyl chloride	129	125 (anh)	298			81, 235	314-5	298-9	323-4	
207	7-Chloronaphthalene-1-sulfonyl chloride	129		235							

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Amide	Anilide	1 Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S-Benzylthiuronium	p-Toluidine	Aniline	o-Toluidine	
208	4,6-Dichloronaphthalene-2-sulfonyl chloride	130		218							
209	2,4,5-Trimethoxybenzenesulfonyl chloride	130		76	170						
210	4,6-Dimethylbenzene-1,3-disulfonyl chloride	130, pet eth		249, w	196, 50% al						
211	5,6,7-Trichloronaphthalene-1-sulfonyl chloride	131		249							
212	Benzene-1,4-disulfonyl chloride	131 139		288	249						
213	5,8-Dichloronaphthalene-2-sulfonyl chloride	134		244							
214	3,7-Dichloronaphthalene-1-sulfonyl chloride	136		269							
215	3-Bromocamphor-8-sulfonyl chloride	136 7									
216	8-Chloro-7-methoxynaphthalene-1-sulfonyl chloride	137		153	196						
217	Benzophenone-3,3'-disulfonyl chloride	137 8		di 157	di 177 8						N-Xanthylsulfonamide, 197
218	Naphthalene-1,3-disulfonyl chloride	137 5		di 292 3							
219	7,8-Dichloronaphthalene-1-sulfonyl chloride	138		221							
220	Azoxybenzene-3,3'-disulfonyl chloride	138	126	di 273							
221	D-Camphor-8-sulfonyl chloride	138		137							
222	3-Methoxynaphthalene-2-sulfonyl chloride	138		113	174						
223	8-Cyanonaphthalene-1-sulfonyl chloride	139		333 4							
224	4-Nitronaphthalene-2-sulfonyl chloride	139 5		225							
225	6-Iodonaphthalene-2-sulfonyl chloride	140		222							
226	8-Iodonaphthalene-1-sulfonyl chloride	140	115	187							
227	4-Nitronaphthalene-2,7-disulfonyl chloride	140 1		286-7							
228	4-Hydroxybenzenesulfonyl chloride	141		176-7			169	202	170	192	
229	4,8-Dichloronaphthalene-2-sulfonyl chloride	141		205							
230	5-Iodonaphthalene-1-sulfonyl chloride	141		239							
231	Pyridine-3-sulfonyl chloride	Hydrochloride, 141 4	357	110 1	145						Hydrazide, 94
232	6,7-Dichloronaphthalene-1-sulfonyl chloride	142		268							
233	Benzene-1,2-disulfonyl chloride	143		254	241						
234	6-Ethoxy-1-nitronaphthalene-2-sulfonyl chloride	146		218							
235	Retene-6-sulfonyl chloride	146 7 5, yel -br	121 3	206 7 5							
236	7-Bromonaphthalene-1-sulfonyl chloride	147		209							
237	4-Acetamidobenzenesulfonyl chloride	149		219	214	215					
238	5,7-Dichloronaphthalene-1-sulfonyl chloride	149		272							

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Amide	Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S-Benzylthuronium	p-Toluidine	Aniline	o-Toluidine	
239	4,5-Dibenzynaphthalene-1-sulfonyl chloride	151		168							
240	4,7-Dichloronaphthalene-1-sulfonyl chloride	151		217							
241	7-Ethoxy-8-nitronaphthalene-1-sulfonyl chloride	155		173-4							
242	2-Amino-5-methylbenzene-1,3-disulfonyl chloride	156, chl		di 257, w	di 196-7, aq al						
243	Phenanthrene-2-sulfonyl chloride	156	150	253-4	157-8			291			Me ester, 101-2, Et ester, 89, yel-br
244	4,7-Dichloronaphthalene-2-sulfonyl chloride	156		196							
245	6,7,8-Trichloronaphthalene-2-sulfonyl chloride	157		245							
246	4,5-Dichloronaphthalene-2-sulfonyl chloride	158		197							
247	5,6,8-Trichloronaphthalene-2-sulfonyl chloride	158		235							
248	Naphthalene-2,7-disulfonyl chloride	158, 162		242			212	299	251-2	238	
249	Naphthalene-1,4-disulfonyl chloride	160-166		273, w, or al	179						
250	4-Carboxy-3-nitrobenzenesulfonyl chloride	di 160	111 (+2½ H <sub>2</sub> O)	192							The m p is that of the 1,4-dichloride, Diamide, 226
251	7-Hydroxynaphthalene-1,3-disulfonyl chloride	161-2			195		228	294		271	
252	Fluorene-2-sulfonyl chloride	164	155 (hyd)	213d							
253	2,5-Dimethylbenzene-1,4-disulfonyl chloride	164		310	223						
254	8-Nitronaphthalene-1-sulfonyl chloride	165 d	115 d (+3H <sub>2</sub> O)	191	178-8-5						
255	7-Iodonaphthalene-1-sulfonyl chloride	165		240							
256	Azobenzene-3,3'-disulfonyl chloride	166		di 305							
257	3,6-Dichloronaphthalene-2-sulfonyl chloride	166		218							
258	5,6-Dichloronaphthalene-2-sulfonyl chloride	167		192							
259	Phthalic acid-4-sulfonyl chloride (3,4-Dicarboxybenzenesulfonyl chloride)	167-70, d eth	138-40 (+1H <sub>2</sub> O)	192-200 d, w							
260	8-Nitronaphthalene-2-sulfonyl chloride	169	135-6 (+1½ H <sub>2</sub> O)	223	172-3						
261	4-Amino-2-hydroxybenzenesulfonyl chloride	169		155							
262	2-Hydroxynaphthalene-1,7-disulfonyl chloride	169		233							
263	7-Nitronaphthalene-1-sulfonyl chloride	169-70		261-2							
264	4,6,7,8-Tetrachloronaphthalene-2-sulfonyl chloride	176		235							
265	4'-Nitrobiphenyl-4-sulfonyl chloride	178		228							
266	Naphthalene-1,5-disulfonyl chloride	183	245 (anh)	310, 340	249		257, 251 d	332			Di-Me ester, 205, chl
267	Anthraquinone-2,7-disulfonyl chloride	186, chl			di 192						

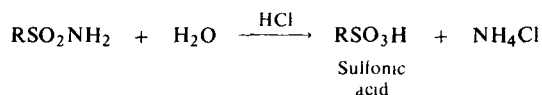
\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1 Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S Benzylthiuronium	p-Toluene	Aniline	o-Toluene	
268	Benzene-1,3,5-trisulfonyl chloride	187		tri 310 5	tri 237						Tri-Et ester, 147, bz
269	7-Hydroxynaphthalene-1,3,6-trisulfonyl chloride	196			152 5						
270	Anthraquinone-2-sulfonyl chloride	197		261	193		211	308	309		Me ester, 123, Et ester, 125
271	Anthraquinone-1,6-disulfonyl chloride	197 8, yel, PhNO <sub>2</sub>	215 7, gold		227 8, yel						
272	Biphenyl-4,4'-disulfonyl chloride	203		300			171	330 d			
273	Benzidine-2,2'-disulfonyl chloride	Hydrochloride, 205		di 278							
274	Anthraquinone-1-sulfonyl chloride	216 8, yel, PhNO <sub>2</sub>	218		214		191		284		NH <sub>3</sub> → 1-Aminoanthraquinone, 252, 243
275	9,10-Dichloroanthracene-2-sulfonyl chloride	221		279	248						
276	Azobenzene-4,4'-disulfonyl chloride	222	169d (anh)	250 d							Et ester, 104
277	Anthraquinone-1,8-disulfonyl chloride	222 3, yel, PhNO <sub>2</sub>	293-4	>340	237-8, yel, PhNO <sub>2</sub>						
278	Anthracene-1,8-disulfonyl chloride	225		333	224						
279	Naphthalene-2,6-disulfonyl chloride	225		305			256		360		
280	2-Hydroxynaphthalene-1,5-disulfonyl chloride	231			231						
281	Anthracene-1,5-disulfonyl chloride	240		di 330	di 293						
282	Anthraquinone-2,6-disulfonyl chloride	250, yel cl bz			di 321						
283	Anthraquinone-1,3-disulfonyl chloride	265 70, yel	310 1 (hyd)	>350	269 70, yel -red						
284	2,4-Diaminobenzene-1,5-disulfonyl chloride	275		187	236						
285	Anthraquinone-1,7-disulfonyl chloride	301 2, br yel, PhNO <sub>2</sub>	120 (hyd)		237-8, yel cl bz						

\*Derivative data given in order m p, crystal color, solvent from which crystallized

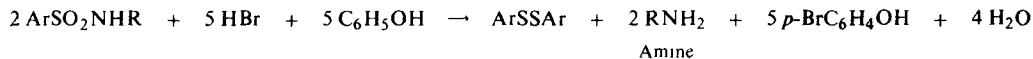
## EXPLANATIONS AND REFERENCES TO TABLE XXIV

*Formation of sulfonic acid by hydrolysis \**

From hydrolysis of the sulfonamide by 25% hydrochloric acid.

For directions and examples see Cheronis, p. 631, Shriner, pp. 104, 267, R. S. Schreiber and R. L. Shriner, *J Amer Chem Soc*, **56**, 1618 (1934).

From hydrolysis of the sulfonamide in a mixture of concentrated sulfuric acid and 85% phosphoric acid  
See Cheronis, p. 633.

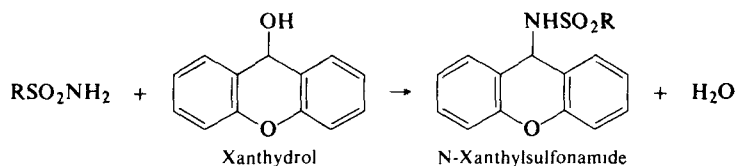
*Formation of the amine by hydrolysis*

From hydrolysis of the sulfonamide in 48% hydrobromic acid and phenol.

For directions and examples see Shriner, pp. 105, 267, H. R. Snyder and R. E. Heckert, *J Amer Chem Soc*, **74**, 2006 (1952); H. R. Snyder and H. C. Geller, *J Amer Chem Soc*, **74**, 4864 (1952).

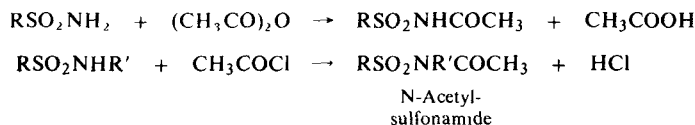
NOTE For directions and explanations for the preparation of derivatives of the sulfonic acid formed by the hydrolysis of the sulfonamide see explanations and references to Table XXII, pp. 369, 370.

For directions and explanations for the preparation of the amine formed by the hydrolysis of the sulfonamide see explanations and references to Table XVIII, pp. 291, 292, 293

*N-Xanthylsulfonamide \**

From the sulfonamide and xanthryol in glacial acetic acid.

For directions and examples see Cheronis, p. 634, Linstead, p. 95; Shriner, p. 267; R. F. Phillips and V. S. Frank, *J Org Chem*, **9**, 9 (1944).

*N-Acetylsulfonamide.*

From the sulfonamide and acetic anhydride.

For directions and examples see Cheronis, p. 634.

From the sulfonamide and acetyl chloride in acetic acid.

See Linstead, p. 95; Vogel, p. 555.

\*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
(Listed in order of increasing m.p.)\*

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid	
				Chloride	Amide	Anilide	1-Naphthylamide	S Benzylthionium	<i>p</i> -Toluidinium	Anilinium	<i>o</i> -Toluidinium		
1	2-Methylpropane-1-sulfonamide	14-6		b p 80 <sup>13</sup>		38	107						
2	<i>N,N</i> -Diethylbenzylsulfonamide	29		92	105, w, al	102	166 (146)		113, al	102	83		
3	2-Methylpropane-1-sulfonanilide	38		b p 80 <sup>13</sup>	14-6		107						
4	3-Methylbutane-1-sulfonanilide	42		b p 98 <sup>13</sup>	3		90 1						
5	Butane-1-sulfonamide	45	-15	b p 75 <sup>10</sup>		10 5	60 5						Phenylhydrazinium salt, 114 5
6	Propane-1-sulfonamide	52, eth	7 5	b p 78 <sup>15</sup>		10	84		67-8				Phenylhydrazinium salt, 204 5d
7	Ethane sulfonamide	58, eth	-17	b p 178		58	66	115					Phenylhydrazinium salt, 182 8
8	Ethane sulfonanilide	58	-17	b p 178	58		66	115					Phenylhydrazinium salt, 182 8
9	<i>N,N</i> -Diethyltoluene-4-sulfonamide	60	104-5	69	105 (dihyd), 138 5 9 (anh)	103	157	181-2	198	238	190		<i>m</i> -Toluidide, 109
10	Propane-2-sulfonamide	60, eth - pet eth	-37	b p 61 <sup>9</sup>		84	134						
11	<i>N</i> -Ethyltoluene-4-sulfonamide	64	104-5	69	105 (dihyd), 138 5-9 (anh)	103	157	181 2	198	238	190		
12	<i>N</i> -Ethylbenzyl sulfonamide	65-6, eth, lgr		92	105, w, al	102	166 (146)		113, al	102	83		
13	<i>N</i> -(1-Naphthyl)ethane sulfonamide	66	-17	b p 178	58	58		115					
14	Ethane-1,2-disulfonanilide	69		<i>di</i> 95, eth				201 2	<i>d at</i> 270	270, w			<i>Di Et</i> ester, 77, eth, <i>m</i> -Toluidide, 230
15	<i>N</i> -Methyltoluene-2-sulfonamide	74-5	57	68		136		170	203 4	218			
16	Heptane-1-sulfonamide	75		16									
17	2,4,5-Trimethoxybenzene sulfonamide	76		130		170							
18	2-Phenylethane-1-sulfonanilide	77	91	33	122								
19	<i>N</i> -Methyltoluene-4-sulfonamide	78 9	104-5	69	105 (dihyd), 138 5-9 (anh)	103	157	181 2	198	238	190		
20	Propane-2-sulfonanilide	84		b p 61 <sup>9</sup>	60		134						
21	<i>N</i> -(1-Naphthyl)propane-1-sulfonamide	84	7 5	b p 78 <sup>15</sup>	52	10			67 8				
22	<i>N,N</i> -Dimethyltoluene-4-sulfonamide	86-7	104-5	69	105 (dihyd), 138 5 9 (anh)	103	157	181 2	198	238	190		
23	Methane sulfonamide	90	20	b p 60 <sup>21</sup>		100 5	125 5						Phenylhydrazinium salt, 193 5-4d
24	<i>N</i> -(1-Naphthyl)-3-methylbutane-1-sulfonamide	90-1		b p 98 <sup>13</sup>	3	42							
25	4-Chloro-3-methylbenzene sulfonanilide	92		63	128								
26	Toluene-3-sulfonanilide	96		12	108				106				

\*Derivative data given in order m p, crystal color, solvent from which crystallized



**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid	
				Chloride	Amide	Amide	1-Naphthyl amide	S-Benzyl thionium	p-Toluidinium	Anilinium	o-Toluidinium		
27	3-Chloro-4-methylbenzene sulfonanilide	96		38	134								
28	3,3-Dimethylbutane sulfonamide	96-7		43 4									
29	Hexadecane-1-sulfonamide	97	54	54									
30	2-Ethylbenzene sulfonamide	100		11 7									
31	10-Bromocamphor-3-sulfonamide	100-2		97									
32	Methane sulfonanilide	100 5	20	b p 60 <sup>21</sup>	90		125 5						Phenylhydrazinium salt, 193 5-4d
33	N,N-Dimethylbenzyl sulfonamide	101		92-3, eth, lgr	105, w, al	102, al	166 (146)		113, al	102	83		Hydrazide, 131 2, Phenylhydrazide, 173
34	Benzyl sulfonanilide (Toluene- $\alpha$ -sulfonanilide)	102, al		92	105, w, al		166 (146)		113, al	102	83		Hydrazide, 131 2, Phenylhydrazide, 173
35	Toluene-4-sulfonanilide	103	92 (104 5)	69	137			181 2	198	238	190		N-Xanthylsulfonamide, 197
36	4-Chlorobenzene sulfonanilide	104	69 (93)	53	144		190	175	208 10	222 3	163 4		
37	Benzyl sulfonamide (Toluene- $\alpha$ -sulfonamide)	105, w, al		92-3, eth, lgr		102, al	166 (146)		113, al	102	83		Hydrazide, 131 2, Phenylhydrazide, 173
38	N-(1-Naphthyl)-2-methylpropane sulfonamide	107		b p 80 <sup>13</sup>	14-6	38							
39	Toluene-3-sulfonamide	108, al		12		96			106		108		
40	2,4-Dimethyl-6-nitrobenzene sulfonamide	108	97										
41	2,4,6-Trimethylbenzene sulfonanilide	109	78	56	142								N-Xanthylsulfonamide, 203
42	N-Methylbenzyl sulfonamide	109-10		92-3, eth, bz	105, w, al	102, al	166 (146)		113, al	102	83		N-Xanthylsulfonamide, 188, Hydrazide, 131 2, Phenylhydrazide, 173
43	2,4-Dimethylbenzene sulfonanilide	110	62 (hyd)	34									
44	4-Ethylbenzene sulfonamide	110		12									N-Xanthylsulfonamide, 196
45	3-Hydroxynaphthalene-2-sulfonamide	110		112						241 2			
46	Pyridine-3-sulfonamide	110-1	357	Hydrochloride, 141-4 d		145							Hydrazide, 94
47	Naphthalene-1-sulfonanilide	112 (152)	90	68, 66	150			137	181	183	237		
48	Benzene sulfonanilide	112	66 (anh)	14 5	156		170 1	148	205	240	176		N-Xanthylsulfonamide, 200
49	3-Methoxynaphthalene-2-sulfonamide	113		138		174							
50	2,6-Dimethylbenzene sulfonamide	113 (96)	98	39									
51	2-(N-Methylamino)benzene sulfonamide	114 5 5 5	182 d										2-N-p-Toluene-sulfonyl deriv of sulfonamide, 193

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthyl amide	S Benzylthuronium	p-Toluidinium	Anilinium	o-Toluidinium	
52	2-Nitrobenzene sulfonanilide	115	70 (85)	69	193							
53	N-Benzyltoluene-4-sulfonamide	115.6	92	69	137			181-2	198	238	190	N-Xanthylsulfonamide, 197
54	8-Methylnaphthalene-2-sulfonamide	116		88								
55	Indane-4-sulfonamide	118.9, w		53-3.5, b p 140-1 <sup>4</sup>								
56	4-Bromobenzene sulfonanilide	119	88.90	76, eth	166, 161		183.5	170	215.6	237.8	182.3	
57	3,5-Dimethylbenzene sulfonanilide	119		94.90	135				121.2 d			
58	6-Methoxynaphthalene-2-sulfonanilide	120		93	189							
59	D-Camphor-10-sulfonanilide	121	193	67	132							
60	7-Methoxynaphthalene-2-sulfonanilide	121		83	220							
61	2-Phenylethane-1-sulfonamide	122	91	33		77						
62	4-Formylbenzene sulfonamide	122.4										Oxime, 158, O,O-Diacetate of sulfonamide, 86-7.5
63	5-Nitronaphthalene-1-sulfonanilide	123		113	236							Me ester, 117.8, chl
64	2-Methylnaphthalene-1-sulfonamide	124		83.5								
65	D-Camphor-3-sulfonanilide	124	77	88	143				196.7			Me ester, 77, [α] <sub>D</sub> +98.6 in chl
66	Biphenyl-4-sulfonanilide	125		115	230							
67	4-Fluorobenzene sulfonamide	125		36.30								
68	N-(1-Naphthyl)methane sulfonamide	125.5	20	b p 60 <sup>21</sup>	90	100.5						
69	3-Nitrobenzene sulfonanilide	126	48	64	167		166.5	146	222	222	193	
70	Phenol-O-sulfonanilide	126.5.7.5	145 (monohyd)						124.5	126.5.7.5		
71	5-Aminonaphthalene-2-sulfonanilide	127.8			219			191				5-N-Acetyl deriv of sulfonamide, 247
73	4-Chloro-3-methylbenzene sulfonamide	128		63		92						Sulfonyl bromide, 67.5
74	6-Fluoronaphthalene-2-sulfonanilide	129	105 (hyd)	97	133							
75	5-Ethoxynaphthalene-1-sulfonanilide	130		121	182.5							
76	3-Chloro-4-methoxybenzene sulfonamide	131		82								
77	4-Aminonaphthalene-2-sulfonamide	131 (hyd)										4-N-Acetyl deriv of sulfonamide, 220
78	2,5-Dimethyl-4-nitrobenzene sulfonanilide	131	140	75	197-8				143.5.4.5		143.5.4.5	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1 Naphthylamide	S Benzylthiouonium	p-Toluidinium	Aminium	o-Toluidinium	
79	3-Ethoxybenzene sulfonamide	131		38								
80	D-Camphor-10-sulfonamide	132	193	67		121 (88)						
81	Naphthalene-2-sulfonanilide	132	91 (hyg)	76 79	217 213							
82	6-Fluoronaphthalene-2-sulfonamide	133	105 (hyd)	97, chl		129		190 1	221	269	213	
83	DL-Camphor-8-sulfonamide	133 5 w	56 8	106								
84	3-Methyl-4-nitrobenzene sulfonamide	133 5		50								
85	3-Chloro-4-methylbenzene sulfonamide	134		38		96						
86	N-(1-Naphthyl)propane-2-sulfonamide	134	-37	b p 61 <sup>a</sup>	60	84						m-Toluidide, 109
87	3,5-Dimethylbenzene sulfonamide	135, al		94, 90, bz		129, al			121 2 al			
88	Tetraline-6-sulfonamide	135		58		155 6						
89	Indane-5-sulfonamide	135 5 6, al	92	46-7, eth b p 148 9 <sup>a</sup>		129, al						
90	Toluene-2-sulfonanilide	136	57	68	156			170	203 4	218		N-Xanthylsulfonamide, 183
91	4-Iodonaphthalene-1-sulfonanilide	136		124 121	206 204							
92	D-Camphor-8-sulfonamide	137		138								[α] <sub>D</sub> <sup>25</sup> +93 6, in al
93	4-Chloro-2-nitrobenzene sulfonanilide	138	82	75	237							
94	2,4-Dimethylbenzene sulfonamide	138	62 (hyd)	34		110		146				N-Xanthylsulfonamide, 188
95	Toluene-4-sulfonamide	138 5 9 0 (anh) 105 (dihyd)	104 5	69		103	157	181 2	198	238	190	N-Xanthylsulfonamide, 197
96	8-Aminonaphthalene-1-sulfonanilide	139 40						300				
97	4-Vinylbenzene sulfonamide	139 40							182 3			Dimethylamide, 62 3
98	2-Bromonaphthalene-1-sulfonamide	140		97								
99	3,4-Dichlorobenzene sulfonamide	140, 135		22 4, 19								
100	2,4,6-Trimethylbenzene sulfonamide	142	78	56		109						N-Xanthylsulfonamide, 203
101	7-Ethoxynaphthalene-2-sulfonamide	142		103		153						
102	3-Aminobenzene sulfonamide	142						148				
103	3,5-Dimethyl-2-hydroxybenzene sulfonanilide	142 3	121 5									2-O-Acetyl deriv of sulfonyl chloride, 62, pet eth
104	D-Camphor-3-sulfonamide	143	77	88		124			196 7			N-Methylanilide, 111 2, Me ester, 77, [α] <sub>D</sub> +98 6 in chl
105	5-Chloro-2-methylbenzene sulfonamide	143	21, 24									

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid	
				Chloride	Amide	Anilide	1 Naphthylamide	S Benzylthuronium	p-Toluidinium	Anilinium	o-Toluidinium		
106	4-Iodobenzene sulfonanilide	143		85	183								
107	2,5-Dimethyl-3-nitrobenzene sulfonanilide	143.4	128 (200)	61	173				135-6			126.5-7.5	
108	4-Methylnaphthalene-2-sulfonamide	143.4		124.5									
109	Benzophenone-2-sulfonanilide	143.5		96.7									
110	4-Ethoxynaphthalene-2-sulfonanilide	143.5		85	183								
111	3,4-Dimethylbenzene sulfonamide	144	64 (55)	52				208					
112	4-Fluoronaphthalene-1-sulfonanilide	144	100 (hyd)	86	206								Et ester, 93
113	4-Chlorobenzene sulfonamide	144	69 (93)	53		104	190	175	208-10	222.3	163.4		
114	4-Methyl-3-nitrobenzene sulfonamide	144.5	92 (hyg)	36		109	153		130.1			28	
115	3-Chloro-6-methylbenzene sulfonamide	145, aq al		24									
116	Pyridine-3-sulfonanilide	145			110.1								
117	3-Bromocamphor-8-sulfonamide	145	195.6 (anh)	136.7									
118	4-Chloronaphthalene-1-sulfonanilide	145.6	130.3	94.5	187		162			145.6	151		Me ester, 83 Et ester, 104
119	4-Bromo-3-methylbenzene sulfonamide	146		50									
120	4-Methoxy-3-nitrobenzene sulfonamide	146.3		66									
121	1-Aminonaphthalene-7-sulfonanilide	147			181 (hyd)								Benzoylguanidine salt, 214.6
122	4-Methoxynaphthalene-2-sulfonanilide	147.5		98.5	226								
123	3-Chlorobenzene sulfonamide	148							199-200	206.7			
124	2-Methyl-5-nitrobenzene sulfonanilide	148	133.5	46-7	186				256.7			256.8	
125	2,5-Dimethylbenzene sulfonamide	148	48 (anhyd) 86 (hyd)	24.6				184					N-Xanthylsulfonamide, 176
126	Benzene-1,3-disulfonanilide	148.50		63	229		245	214					N-Xanthylsulfonamide, 170
127	6-Methoxynaphthalene-1-sulfonamide	149.5		80.5		177.5							
128	Naphthalene-1-sulfonamide	150	90	68, 66		112 (152)		137	181	183	237		
129	4-Ethoxybenzene sulfonamide	150		39									
130	4,6-Dichloro-2,5-dimethylbenzene sulfonamide	150		81		175							
131	3-Bromo-4-methylbenzene sulfonamide	151		60									
132	2-Hydroxynaphthalene-3,6,8-trisulfonanilide	152-5		tri 196									
133	7-Ethoxynaphthalene-2-sulfonanilide	153		103	142								
134	2-Chloronaphthalene-1-sulfonamide	153		75									

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid	
				Chloride	Amide	Anilide	1-Naphthyl amide	S Benzyl thionium	p Tolu dinium	Ani linum	o Tolu dinium		
135	8-Chloro-7-methoxynaphthalene-1-sulfonamide	153		137		196							
136	2-Aminobenzene sulfonamide	153						132					2-N Benzoyl deriv of sulfonamide 198, Hydro chloride, 201
137	5-Methylbenzene-1,3-disulfonanilide	153, al		94, eth	216, w								
138	6-Ethoxynaphthalene-2-sulfonanilide	153		107 5	183								
139	2-Iodonaphthalene-1-sulfonamide	154		110									
140	6-Ethoxynaphthalene-1-sulfonamide	154		118		194 5							
141	2,6-Dichloro-4-methylbenzene sulfonamide	154-5		56									
142	4-Chloro-2,5-dimethylbenzene sulfonanilide	155	100	50	185								
143	4-Amino-2-hydroxybenzene sulfonamide	155		169									
144	Tetraline-6-sulfonanilide	155 6		58	135								
145	Benzene sulfonamide	156 (153)	43 4 (mono-hyd), 66 (anh)	14 5			170 1	148	205	240	176		N Xanthylsulfonamide, 200
146	2-Chloro-5-methylbenzene sulfonamide	156		56		229-30 5							
147	D-3-Bromocamphor-10-sulfonamide	156	47 5	65									
148	Toluene-2-sulfonamide	156 3	57	68		136		170	203 4	218			N Xanthylsulfonamide, 182-3,5
149	4-Methoxynaphthalene-2-sulfonamide	157		75 5	145								
150	5-Methoxynaphthalene-1-sulfonanilide	157		119 5	194 5								
151	N-(1-Naphthyl)toluene-4-sulfonamide	157	104-5	69	105 (dihyd), 138 5 9 (anh)	103		181 2	198	238	190		
152	Benzophenone-3,3'-disulfonamide	157		di 137-8		di 177 8							N-Xanthylsulfonamide, 197 Hydrazide 110
153	2,4-Dinitrobenzene sulfonamide	157, 154	106 8 (hyd), 130 (anh)	102									
154	2-Methyl-4-nitrobenzene sulfonamide	157		106									
155	2-Nitrodiphenylamine-4-sulfonanilide	157	220d		162								
156	Phenanthrene-2-sulfonanilide	157 8	150	156	253-4				291				Me ester, 101 2, Et ester, 89, yel-br
157	4-Methylnaphthalene-1-sulfonanilide	158		81	174, 177								
158	2-Ethoxynaphthalene-1-sulfonamide	158		116		187							
159	4-Methoxynaphthalene-1-sulfonanilide	158		81	177								

\* Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid	
				Chloride	Amide	Anilide	1-Naphthyl amide	S-Benzylthionium	p-Toluidinium	Anilinium	o-Toluidinium		
160	2-Ethoxybenzene sulfonanilide	158		65.6	163								Phenylhydrazide, 132.3
161	2-Methoxynaphthalene-1-sulfonamide	159		121		196.5							
162	3-Nitrobenzylsulfonamide (3-Nitrotoluene- $\alpha$ -sulfonamide)	159d, w	74 (hyd)	100 bz									Me amide, 106.7; Dimethylamide, 118.9
163	5-Amino-2-hydroxybenzene sulfonanilide	159 (98)	100 (anh)		202 d								
164	5-Chloro-2-nitrobenzene sulfonamide	159		93									
165	2,5-Dichlorobenzene sulfonanilide	160	93.7	38	181			170					
166	3,5-Dimethyl-2-hydroxybenzene-1,4-disulfonamide	160.1		dt 89.91									
167	6-Hydroxynaphthalene-2-sulfonanilide	161	129 (hyd) 167 (anhyd)		238			217 (207)	247	264	208		
168	2-Methylbenzene-1,3-disulfonanilide	162		88	260								
169	N-(1-Naphthyl)-4-chloronaphthalene-1-sulfonamide	162	130.3	94.5	187	145.6				145.6	151		Me ester, 83; Et ester, 104
170	2-Nitrodiphenylamine-4-sulfonamide	162	220 d			157							
171	7-Methylnaphthalene-1-sulfonanilide	162.4		96	197								
172	2-Ethoxybenzene sulfonamide	163		65.6		158							Phenylhydrazide, 132.3
173	7-Methylnaphthalene-2-sulfonamide	163.4		63.4									
174	3-Methyl-2-nitrobenzene sulfonamide	163.5		58.5									
175	5-Amino-2-methylbenzene sulfonamide	164				146.7							5-N-Acetyl deriv of sulfonamide, 242
176	4-Chloro-2-nitrobenzene sulfonamide	164		75		138							Phenylhydrazide, 151; Ph ester, 82
177	4-Nitrodiphenylamine-2-sulfonanilide	164		102.4	174								
178	4-Aminobenzene sulfonamide	165				200	196	185					
179	3,6-Dichloro-2,5-dimethylbenzene sulfonamide	165		71		171							
180	6-Aminonaphthalene-1-sulfonamide	165						172.4					Benzoylguanidine salt, 210.1
181	N-(1-Naphthyl)benzyl sulfonamide	166 (146)		92.3, eth, bz	105, w, al	102, al			113, al	102	83		Hydrazide, 131.2; Phenylhydrazide, 173
182	4-Bromobenzene sulfonamide	166, 161	88-90	76, eth		119	183.5	170	215-6	237-8	182-3		
183	5-Bromo-2-methylbenzene sulfonamide	166.7		33-5									
184	N-(1-Naphthyl)-3-nitrobenzene sulfonamide	166.5	48	64	167	126		146	222	126.5-7.5	193		
185	3-Nitrobenzene sulfonamide	167	48	64		126	166.5	146	222	126.5-7.5	193		

\* Derivative data given in order: m.p., crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1 Naphthylamide	S-Benzylthiuronium	p-Toluidinium	Anilinium	o-Toluidinium	
186	2,4-Dimethoxybenzene sulfonamide	167		70								
187	5-Chloro-2-methyl-3-nitrobenzene sulfonamide	167		60								
188	4-Hydroxynaphthalene-1-sulfonamide	167				199-200						
189	2,3-Dimethylbenzene sulfonamide	167		47								
190	4,6-Dichloro-2-methylbenzene sulfonamide	168		43								
191	4-Chloronaphthalene-2-sulfonamide	168		106								Et ester, 76 9
192	4,5-Dibenzyl-naphthalene-1-sulfonamide	168		151								
193	4-Bromo-2-methylbenzene sulfonamide	168		50								
194	Propane-1,3-disulfonamide	169, w	92 d	di 45		di 125						Di-m-toluidide, 222, Di-hydrazide, 105
195	Propane-1,1-disulfonamide	169 70				151-2, al						
196	2,4,5-Trimethoxybenzene sulfonanilide	170		130	76							
197	4-Acetamidonaphthalene-1-sulfonanilide	170			241							
198	4-Ethoxynaphthalene-1-sulfonamide	170		103		180						
199	3-Carboxybenzene sulfonamide	di 170	98 (hyd ), 148 (anh )	di 20				163	224-6			
200	4-Methyl-2-nitrobenzene sulfonamide	170		98 9								o-Anisidide, 135
201	N-(1-Naphthyl)benzene sulfonamide	170-1	43-4 (mono-hyd ), 66 (anh )	14 5	156	112		148	205	240	176	Me ester, b p 150 <sup>15</sup> , N-Xanthylsulfonamide, 200
202	3,6-Dichloro-2,5-dimethylbenzene sulfonanilide	171		71	165							
203	5-Aminonaphthalene-1-sulfonanilide	171			260			179				
204	4-Nitrobenzene sulfonanilide	171 (136)	109 11 (95)	80, lgr	180				179-80			
205	2,4-Dimethyl-3-nitrobenzene sulfonamide	172	144 (anh )	96								
206	8-Nitronaphthalene-2-sulfonanilide	172-3	135 6 (hyd )	169	223							
207	2,5-Dimethyl-3-nitrobenzene sulfonamide	173	128 (200)	61		143 4			136			
208	4-Nitrodiphenylamine-2-sulfonamide	173		102 4		164						
209	7-Ethoxy-8-nitronaphthalene-1-sulfonamide	173 4		155								
210	2,5-Dimethylbenzene-1,3-disulfonanilide	174, al		81, lgr	295, al							
211	3-Methoxynaphthalene-2-sulfonanilide	174		138	113							
212	3,4-Dibromobenzene sulfonamide	175	66 5-7 5 (anhyd )	34								

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid	
				Chloride	Amide	Anilide	1-Naphthylamide	S-Benzylthiuronium	p-Toluidinium	Anilinium	o-Toluidinium		
213	4,6-Dichloro-2,5-dimethylbenzene sulfonanilide	175		81	150								
214	4-Chloro-3-nitrobenzene sulfonamide	175 6, yel. al		40 1 (60 2)									
215	7-Chloronaphthalene-2-sulfonamide	176	68 (tetrahyd) 118 (anhyd)	87									Me ester, 89, Et ester, 65
216	3-Amino-4-methylbenzene sulfonamide	176											3-N-Benzoyl deriv of sulfonamide, 203, 3-N-Acetyl deriv of sulfonyl chloride, 144, 3-N-Benzoyl deriv of sulfonyl chloride, 196
217	4-Bromo-3-nitrobenzene sulfonamide	176-7		55 7									
218	4-Hydroxybenzene sulfonamide	176 7		141				169	202	170	192		
219	5-Methylnaphthalene-1-sulfonamide	176 8	115										
220	4-Methylnaphthalene-1-sulfonamide	177 d 174		81, lgr		158							
221	2-Chloro-5-methyl-6-nitrobenzene sulfonamide	177		122									
222	Benzophenone-3,3-disulfonanilide	177 8		di 137 8	di 157								
223	6-Methoxynaphthalene-1-sulfonanilide	177 5		80 5	149 5								
224	Acenaphthene-5-sulfonanilide	178		111	223								
225	2-Methylbenzene-1,4-disulfonanilide	di 178		98	224								
226	8-Nitronaphthalene-1-sulfonanilide	178 8 5	115 (trihyd)	165 d	190 5 1 5								
227	Naphthalene-1,4-disulfonanilide	179		160 (166)	273, w, al								
228	4-Nitrobenzene sulfonamide	180, 50° al	109 11 (95) (hyg)	80, lgr		171 (136) d		179 80					
229	4-Ethoxynaphthalene-1-sulfonanilide	180		103	170								
230	3,4-Dimethyl-5-nitrobenzene sulfonamide	180		70									
231	3-Chloro-2-methylbenzene sulfonamide	180 w	60-72	72, pet eth									
232	2-Aminonaphthalene-8-sulfonamide	181 (hyd)				147							1-N-Acetyl deriv of sulfonamide, 213, Benzoylguanidine salt, 214-6
233	2,5-Dichlorobenzene sulfonamide	181	93 7 (>100)	38		160	160	170	247-8	262-3	250-1		
234	2,4,5-Trimethylbenzene sulfonamide	181	112	61									

\*Derivative data given in order m.p., crystal color, solvent from which crystallized



**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid	
				Chloride	Amide	Anilide	1-Naphthylamide	S-Benzylthiuronium	p-Toluidinium	Anilinium	o-Toluidinium		
235	5-Chloro-4-methyl-2-nitrobenzene sulfonamide	181	128	99									
236	2,4-Dichlorobenzene sulfonamide	182	86	55					204 6			170 2	
237	2,5-Dimethyl-6-nitrobenzene sulfonanilide	182	145 (anh)	110	192				158 5 9, al			143 5, 50 <sup>o</sup> , al	
238	5-Ethoxynaphthalene-1-sulfonamide	182 5		121		130							
239	6-Ethoxynaphthalene-2-sulfonamide	183		107 5		153							
240	4-Iodobenzene sulfonamide	183		85		143							
241	4-Ethoxynaphthalene-2-sulfonamide	183		85		143 5							
242	Quinoline-8-sulfonamide	183-4	312	124									Me ester, 96, Et ester, 73, Picrate of Na salt, 226-7
243	4,5-Dichloro-3-methylbenzene sulfonamide	183-5		85 8									
244	N-(1-Naphthyl)-4-bromobenzene sulfonamide	183 5	88 90	76, eth	166 161	119		170	215 6	237-8		182 3	
245	6-Chloronaphthalene-2-sulfonamide	184		110 5									
246	5-Nitronaphthalene-2-sulfonamide	184	118 9, yel	125						260 d			
247	8-Chloronaphthalene-2-sulfonamide	185		94									
248	4-Chloro-2-methylbenzene sulfonamide	185		54									
249	4-Chloro-2,5-dimethylbenzene sulfonamide	185	100	50		155							
250	2-Carboxy-5-methylbenzene sulfonamide (4-Toluic acid-2-sulfonamide)	185	190 (158) (anh)	di 59									
251	2-Chloro-5-nitrobenzene sulfonamide	185-6	168-9 d (hyd)	90, w									
252	2-Bromobenzene sulfonamide	186, w		51, eth									
253	3,5-Dichloro-2-methylbenzene sulfonamide	186		54									
254	2-Methyl-5-nitrobenzene sulfonamide	186	133 5 (dihyd)	46-7, b p 183-5 <sup>10</sup>		148			256-7			256-8	
255	2-Chloro-4-methylbenzene sulfonamide	186		46, 52									
256	4-Methylbenzene-1,3-disulfonamide (Toluene-2,4-disulfonamide)	186-7 (191)		54, 46		189			277 d	di 189	di	170-1	Di-m-toluidide, 138
257	2-Ethoxynaphthalene-1-sulfonamide	187		116	158								
258	4-Chloronaphthalene-1-sulfonamide	187	130 3 d	94-5		145-6	162			145-6	151		Me ester, 83, Et ester, 104
259	8-Iodonaphthalene-1-sulfonamide	187	115	140									

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1 Naphthyl amide	S-Benzyl thiu ronium	p-Toluidinium	Anilinium	o-Toluidinium	
260	2,4-Dimethyl-5-nitrobenzene sulfonamide	187 (179)	132 (122) dil HNO <sub>3</sub>	98								Sulfonyl chloride, 109 10
261	2,4-Diaminobenzene-1,5-disulfonamide	187		275		236						
262	8-Bromonaphthalene-2-sulfonamide	187		121								
263	2-Chlorobenzene sulfonamide	188		28 5								
264	4-Nitronaphthalene-1-sulfonamide	188		99								
265	2,6-Dichloro-3-methylbenzene sulfonamide	188		19 5								
266	5-Methylnaphthalene-2-sulfonamide	188 9		120 2		248 50 (133 4)						
267	4-Methylbenzene-1,3-disulfonanilide	189		54, 46	186-7							
268	6-Methoxynaphthalene-2-sulfonamide	189		93		120						
269	Sulfanilylguanidine (Sulfaguanidine)	189 90 (anh), 143 (hyd)										4-N-Acetyl deriv of sulfonamide, 262 6 (248 51) Hydrochloride, 205 6
270	N-(1-Naphthyl)-4-chlorobenzene sulfonamide	190	69 (93)	53	144	104		175	208-10	222 3	163 4	
271	2,4-Dibromobenzene sulfonamide	190	110 (anh)	79, eth								
272	4-Methylbenzene-1,2-disulfonanilide (Toluene-3,4-disulfonanilide)	190		109 11	237 9							
273	Phenanthrene-3-sulfonamide	190	175-6 (anh), 120-1 (monohyd) 88 d (dihyd)	110 1				222				Me ester, 119 20, al Et ester, 107-8
274	4-Aminonaphthalene-1-sulfonanilide	190										4-N-Acetyl deriv of sulfonamide, 247
275	8-Nitronaphthalene-1-sulfonamide	191	115 d (trihyd)	165 d		178-8 5						
276	2-Hydroxynaphthalene-1,6-disulfonanilide	191		di 111								
277	3,5-Dichloro-4-methylbenzene sulfonamide	191		69								
278	Sulfapyridine	191-2										4-N-Acetyl deriv of sulfonamide, 226 7, acet
279	Anthraquinone-2,7-disulfonanilide	192		di 186 chl								
280	4-Carboxy-3-nitrobenzene sulfonamide (2-Nitrobenzoic acid-4-sulfonamide)	192	111 (+2½ H <sub>2</sub> O)	di 160								Diamide, 226
281	Quinoline-6-sulfonamide	192	>260	91								
282	5,6-Dichloronaphthalene-2-sulfonamide	192		167								

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid	
				Chloride	Amide	Anilide	1-Naphthyl amide	S Benzylthionium	p-Toluidinium	Anilinium	o-Toluidinium		
283	Anthraquinone-2,7-disulfonamide	192		186									
284	2,5-Dimethyl-6-nitrobenzene sulfonamide	192	145 (anh)	110		182			158.5 9			143.5, 50° al	
285	2-Amino-5-methylbenzene-1,3-disulfonanilide	192		156	257								
286	Methane disulfonanilide	192.3	220.7 <sup>13</sup> d	8 b p 133 <sup>m</sup>	dt 233								
287	3,4-Dicarboxybenzene sulfonamide (Phthalic acid-4 sulfonamide)	192.200 d w	138.40 (mono-hyd)	167.70 d eth									
288	2-Nitrobenzene sulfonamide	193	70 (85)	69		115							
289	Anthraquinone-2-sulfonanilide	193		197	261			211	308	309			Me ester, 123 Et ester, 125
290	Phenanthrene-9-sulfonamide	193.4	174 (anh)	127					235				Me ester, 106, me al Et ester, 108, al
291	2-Carboxybenzene sulfonanilide	194.5	68.9 (hyd) 134 (anh)	79, pet eth				206	196 (200)	165	127.8		
292	5-Methoxynaphthalene-1-sulfonamide	194.5		119.5		157							
293	6-Ethoxynaphthalene-1-sulfonanilide	194.5		118	154								
294	7-Hydroxynaphthalene-1,3-disulfonanilide	195		161.2				228	294		271		
295	4-Bromonaphthalene-1-sulfonamide	195		87									
296	7-Hydroxynaphthalene-1-sulfonanilide	195						218	232	240	242		
297	2,5-Dibromobenzene sulfonamide	195	128 (anh)	71									
298	7-Methylnaphthalene-1-sulfonamide	195.6		96		162.4							
299	4,6-Dimethylbenzene-1,3-disulfonanilide	196, 50° al		130, pet eth	249, w								
300	4,7-Dichloronaphthalene-2-sulfonamide	196		156									
301	N-(1-Naphthyl)-4-aminobenzene sulfonamide	196			165	200		185					
302	8-Chloro-7-methoxynaphthalene-1-sulfonanilide	196		137	153								
303	5-Fluoronaphthalene-1-sulfonamide	196.7	105 (hyd)	122.3									Me ester, 118, eth
304	2-Methoxynaphthalene-1-sulfonanilide	196.5		121	159								
305	8-Chloronaphthalene-1-sulfonamide	197		101									
306	4,5-Dichloronaphthalene-2-sulfonamide	197		158									
307	2,5-Dimethyl-4-nitrobenzene sulfonamide	197.8	140	75		131			143.5 4.5		143.5 4.5		

\*Derivative data given in order m p crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid	
				Chloride	Amide	Anilide	1-Naphthylamide	S-Benzylthiuronium	p-Toluidinium	Anilinium	o-Toluidinium		
308	Sulfamethazine (Sulfadimethylpyrimidine)	198 9 (+½ H <sub>2</sub> O), pa yel											4-N-Acetyl deriv of sulfonamide, 249 50
309	Acenaphthene-3-sulfonamide	199	87 9	113 4		284 6							Me ester, 122 3. Et ester, 137 9, lgr
310	4-Hydroxynaphthalene-1-sulfonanilide	199 200	170		167			103	196	186-7	203 4		2-Naphthyl sulfonamide, 204
311	4-Aminobenzene sulfonanilide	200			165		196	185	109		132		4-N-Acetyl deriv of sulfonanilide, 214, Me ester, 92
312	4,5-Dimethylbenzene-1,3-disulfonanilide	200, al		79, yel	239								
313	4-Chloro-3-methyl-5-nitrobenzene sulfonamide	201		52									
314	Anthracene-2-sulfonanilide	201		122	261								Phenylhydrazide, 210, Me ester, 157, Et ester, 160
315	5-Hydroxynaphthalene-1-sulfonanilide	201	110 2 d										O-Acetyl deriv of sulfonyl chloride, 129
316	2-Hydroxynaphthalene-3,6-disulfonanilide	202						233	250	254	257		
317	5-Amino-2-hydroxybenzene sulfonamide	202 d	100 (anh)			159 (98)							
318	1-Nitronaphthalene-2-sulfonanilide	202	105, grn	121, bz - pet eth	214								
319	Sulfathiazole	202 5											4-N-Acetyl deriv of sulfonamide, 256 7
320	4-Nitrobenzyl sulfonamide (4-Nitrotoluene-α-sulfonamide)	204	71	90	220 d								
321	Anthracene-1-sulfonamide	205		90									
322	4,8-Dichloronaphthalene-2-sulfonamide	205		141									
323	3-Amino-4-hydroxybenzene sulfonamide	205 (170)	155-6 d										
324	4-Hydroxybenzene-1,3-disulfonanilide (Phenol-2,4-disulfonanilide)	205	> 100 d	89	239								
325	6-Methylnaphthalene-2-sulfonamide	205-6		97 8									
326	2,6-Dimethyl-4-hydroxybenzene-1,3-disulfonanilide	205-7		117-8	206-8								
327	4-Iodonaphthalene-1-sulfonamide	206, 204		124, 121		136							
328	4-Fluoronaphthalene-1-sulfonamide	206	100 (hyd)	86		144							Et ester, 93
330	4-Amino-3-nitrobenzene sulfonamide	206 7		59-60									

\* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthylamide	S Benzylthiuronium	p-Toluidinium	Anilinium	o-Toluidinium	
331	Retene-6-sulfonamide	206 7 5	121 3	146 7 5, yel -br 117-8								Me ester, 117 9, Et ester, 114-5
332	2,6-Dimethyl-4-hydroxybenzene-1,3-disulfonamide	206 8				205 7						
333	3,7-Diethylnaphthalene-1-sulfonamide	207		105 7								
334	6-Bromonaphthalene-2-sulfonamide	207		124								
335	7-Bromonaphthalene-1-sulfonamide	209		147								
336	4-Methoxybenzene-1,3-disulfonanilide	209		86	240							
337	7-Iodonaphthalene-2-sulfonamide	210		100								
338	4-(N-Methylamino)benzene sulfonamide	210 11	244 5 d									p-Toluenesulfonate, benzidine salt, 255
339	2,4,6-Trichlorobenzene sulfonamide	210-2 d		35 40								
340	4-Aminonaphthalene-1-sulfonamide	212				190						
341	6-Iodonaphthalene-1-sulfonamide	213		92 5								
342	Fluorene-2-sulfonamide	213 d	155 (hyd)	164								
343	Anthraquinone-1-sulfonanilide	214	218	216-8, yel, PhNO <sub>2</sub>				191		284		NH <sub>3</sub> → 1-Aminoanthraquinone, 252 (243)
344	1-Nitronaphthalene-2-sulfonamide	214	105, grn	121, pink, bz -pet eth		202						
345	4-Acetamidobenzene sulfonanilide	214		149	219		215					
346	6-Chloronaphthalene-1-sulfonamide	214		70								Et ester, 114-5
347	N-(1-Naphthyl)-4-acetamidobenzene sulfonamide	215		149	219	214						
348	2,5-Dichlorobenzene-1,3-disulfonamide	215 7		114								
349	5-Methylbenzene-1,3-disulfonamide	216, w		94, eth		153, al						
350	5-Chloronaphthalene-2-sulfonamide	216		115								
351	Naphthalene-2-sulfonamide	217, 213	91 (hyg.), (122)	76, 79		132		190 1	221	269	213	
352	4,7-Dichloronaphthalene-1-sulfonamide	217		151								
353	6-Bromonaphthalene-1-sulfonamide	217		77								
354	4,6-Dichloronaphthalene-2-sulfonamide	218		136								
355	7-Bromonaphthalene-2-sulfonamide	218		100								
356	3,6-Dichloronaphthalene-2-sulfonamide	218		166								

\* Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid	
				Chloride	Amide	Anilide	1-Naphthyl amide	S-Benzylthiuronium	p-Toluidinium	Anilinium	o-Toluidinium		
157	6-Ethoxy-1-nitronaphthalene-2-sulfonamide	218		146									
158	5-Aminonaphthalene-2-sulfonamide	218 9 d				127 8							1-N-Acetyl deriv of sulfonamide, 238 9
59	4-Acetamidobenzene sulfonamide	219		149		214	215						
60	5-Bromonaphthalene-2-sulfonamide	220		96									
61	4-Nitrobenzyl sulfonanilide (4-Nitrotoluene- $\alpha$ -sulfonanilide)	220 d	71	90	204								
62	7-Methoxynaphthalene-2-sulfonamide	220		83		121							
163	2,4,6-Tribromobenzene sulfonanilide	220 2 d	64	64	228								
164	7,8-Dichloronaphthalene-1-sulfonamide	221		138									
165	8-Hydroxynaphthalene-1-sulfonamide	222 d	107 (hyg)										
166	6-Iodonaphthalene-2-sulfonamide	222		140									
167	2,5-Dimethylbenzene-1,4-disulfonanilide	223		164	310								
168	5,6-Dichloronaphthalene-1-sulfonamide	223		106									
169	Acenaphthene-5-sulfonamide	223		111		178							
170	6-Nitronaphthalene-1-sulfonamide	223-4		127									
171	2-Methylbenzene-1,4-disulfonamide	224		98		di 178							
172	5-Chlorobenzene-1,3-disulfonamide	224		106									
173	Anthracene-1,8-disulfonanilide	224		225	333								
174	4-Nitronaphthalene-2-sulfonamide	225		139 5									
175	4,6-Dichloronaphthalene-1-sulfonamide	226		119									
176	4-Carboxamido-3-nitrobenzene sulfonamide (2-Nitrobenzamide-4-sulfonamide)	226	111 (+2.5 H <sub>2</sub> O)	di 160	192								
177	5-Chloronaphthalene-1-sulfonamide	226		95		138							Sulfonyl bromide, 110, Me ester, 89, Et ester, 46
178	4-Methoxynaphthalene-1-sulfonamide	226		98 5		147 5							
179	3,4-Di-iodobenzene sulfonamide	227, aq al	122 5	82, bz - pet eth 124									
180	7,8-Dichloronaphthalene-2-sulfonamide	227											
181	Anthraquinone-1,6-disulfonanilide	227 8, yel	215 7, gold	197-8, yel, PhNO <sub>2</sub>									
182	2,3,4-Trichlorobenzene sulfonamide	227-30		64 5									

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid	
				Chloride	Amide	Amide	1 Naphthyl amide	S-Benzylthiuronium	p-Toluidinium	Anilinium	o-Toluidinium		
383	3,4-Dichloro-2-methylbenzene sulfonamide	228		51	2								
384	4'-Nitrobiphenyl-4-sulfonamide	228		178									
385	2,4,6-Tribromobenzene sulfonamide	228	64	64		220	2 d						
386	8-Nitronaphthalene-2-sulfonamide	228 223	135 6 (+15 H <sub>2</sub> O)	169		172	3						
387	6,8-Dichloronaphthalene-2-sulfonamide	228		121									
388	Benzene-1,3-disulfonamide	229		63		148-50	245	214					N-Xanthylsulfonamide, 170, Alk fusion → resorcinol, 110
389	4,5-Dichloronaphthalene-1-sulfonamide	229		117									
390	Biphenyl-4-sulfonamide	230		115		125							
391	2,4-Di-iodobenzene sulfonamide	230	167 (anh)	77	8								Me ester, 78, al, Et ester, 52, al
392	2-Hydroxynaphthalene-1,5-disulfonamide	231		di	231								
393	5-Bromonaphthalene-1-sulfonamide	232-3		95									
394	2-Hydroxynaphthalene-1,7-disulfonamide	233		169									
395	Methane disulfonamide	233	b p 220 70 <sup>15-20</sup> d	di	8, b p 133 <sup>10</sup>	di	192-3						
396	2-Ethoxybenzene-1,4-disulfonamide	233		di	106 8								
397	3,5-Dinitrobenzene sulfonamide	235		99, chl, lgr									
398	4-Aminobenzene-1,3-disulfonamide (Aniline-2,4-disulfonamide)	235, w	120 d										
399	7-Chloronaphthalene-1-sulfonamide	235		129									
400	5,6,8-Trichloronaphthalene-2-sulfonamide	235		158									
401	4,6,7,8-Tetrachloronaphthalene-2-sulfonamide	235		176									
402	5-Nitronaphthalene-1-sulfonamide	236		113		123							
403	4-Carboxamidobenzene sulfonamide	236	94 (hyd) 260 (anh)	di	57	di	252						
404	2,4-Diaminobenzene-1,5-disulfonamide	236		275	187								
405	2,3-Dichloro-4-methylbenzene sulfonamide	237		41									
406	Benzene-1,3,5-trisulfonamide	tri 237	> 100	tri	187	tri	310 5						Tri-Et ester, 147, bz
408	Anthraquinone-1,7-disulfonamide	237-8, yel, cl bz	120 (hyd)	321-2, br -yel, PhNO <sub>2</sub>									
409	Anthraquinone-1,8-disulfonamide	237-8, yel, PhNO <sub>2</sub>	293-4	222 3	> 340								
410	4-Methylbenzene-1,2-disulfonamide	237 9		109-11		190							

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1 Naphthyl amide	S-Benzylthiuronium	p-Toluidinium	Anilinium	o-Toluidinium	
411	6-Hydroxynaphthalene-2-sulfonamide	238	129 (hyd ) 167 (anh )			161		217 (207)	248	264	208	
412	4-Hydroxybenzene-1,3-disulfonamide (Phenol-2,4-disulfonamide)	239	>100 d	89		205						
413	5-Iodonaphthalene-1-sulfonamide	239		141								
414	4,5-Dimethylbenzene-1,3-disulfonamide	239		79, yel		200, al						
415	7-Iodonaphthalene-1-sulfonamide	240		165								
416	4-Methoxybenzene-1,3-disulfonamide	240		86		209						
417	4-Acetamidonaphthalene-1-sulfonamide	241				170						
418	Benzene-1,2-disulfonanilide	241		143	254			206				
419	5-Nitrobenzene-1,3-disulfonamide	242		di 97 8								
420	Naphthalene-2,7-disulfonamide	242		158 162				212	299	251-2	238	
421	2,4,6-Trimethylbenzene-1,3-disulfonamide	244		di 125		di 150 1						
422	5,8-Dichloronaphthalene-2-sulfonamide	244		134								
423	2,3,4,6-Tetrabromobenzene sulfonamide	245 d		96 5								
424	6,7,8-Trichloronaphthalene-2-sulfonamide	245		157								
425	N,N'-Di(1-naphthyl)benzene-1,3-disulfonamide	245		63	229	148 50		214				Alk fusion → resorcinol, 110, N-Xanthylsulfonamide, 170
426	Anthraquinone-1,5-disulfonamide	246 (350)	310 d	265-70		270 d						
427	1-Iodonaphthalene-2-sulfonamide	247		94								
428	9,10-Dichloroanthracene-2-sulfonanilide	248		221	279							
430	5-Methylnaphthalene-2-sulfonanilide	248-50		120-2	188 9							
431	4,6-Dimethylbenzene-1,3-disulfonamide	249, w		130, pet eth		196, 50% al						
432	Benzene-1,4-disulfonanilide	249		131 (139)	288							
433	5,6,7-Trichloronaphthalene-1-sulfonamide	249		131								
434	Naphthalene-1,5-disulfonanilide	249	245 (anh )	di 183	310 (340)			257 251 d	332			Di-Me ester, 205, chl
435	1-Chloronaphthalene-2-sulfonamide	250	130 3d (anh )	84 5		171 2						
436	Azobenzene-4,4'-disulfonamide	250 d	169d (anh )	di 222								Et ester, 104
437	4-Carboxanilidobenzene sulfonanilide	252	94 (hyd ), 260 (anh )	di 57	di 236							

\* Derivative data given in order m p , crystal color, solvent from which crystallized



TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid	
				Chloride	Amide	Anilide	1-Naphthyl amide	S-Benzylthiuronium	p-Toluidinium	Anilinium	o-Toluidinium		
438	Phenanthrene-2-sulfonamide	253.4	150	156		157.8				291			Me ester, 101-2, Et ester, 89, yel-br
439	Benzene-1,2-disulfonamide	254		143		241		206					
440	2-Amino-5-methylbenzene-1,3-disulfonamide	257		156		192							
441	2-Amino-5-methylbenzene-1,4-disulfonamide	257, w	290	di 156, chl		di 196-7, aq al							
442	5-Aminonaphthalene-1-sulfonamide	260				171		179					5-N-Acetyl deriv of sulfonamide, 231-2
443	2-Methylbenzene-1,3-disulfonamide	260		88		162							
444	Anthracene-2-sulfonamide	261		122		201							Me ester, 157, Et ester, 160
445	Anthraquinone-2-sulfonamide	261		197		193		211	308	309			Me ester, 123, Et ester, 125
446	7-Nitronaphthalene-1-sulfonamide	261-2		169.70									
447	6,7-Dichloronaphthalene-1-sulfonamide	268		142									
448	3,7-Dichloronaphthalene-1-sulfonamide	269		136									
449	Anthraquinone-2,6-disulfonamide	269-70	310.11 (hyd)	265.70, yel	> 350								
450	Anthraquinone-1,5-disulfonamide	270 d	310 d	265-70	246 (350)								
451	1-Bromonaphthalene-2-sulfonamide	271		93									
452	5,7-Dichloronaphthalene-1-sulfonamide	272		149									
453	Naphthalene-1,4-disulfonamide	273, w, al		160 (166)		179							
454	Azoxybenzene-3,3'-disulfonamide	273	126	di 138									
455	4,6-Dichlorobenzene-1,3-disulfonamide	276		123									
456	Benzidine-2,2'-disulfonamide	278		Hydrochloride, 205									
457	9,10-Dichloroanthracene-2-sulfonamide	279		221		248							
458	1,5-Dichloronaphthalene-2-sulfonamide	282		125									
459	4-Nitronaphthalene-2,7-disulfonamide	286-7		140.1									
460	Azobenzene-3,4'-disulfonamide	288		123.5									
461	Benzene-1,4-disulfonamide	288		131 (139)		249							
462	Naphthalene-1,3-disulfonamide	292.3		di 137.5									
463	Anthracene-1,5-disulfonamide	293		di 240	di > 330								
464	2,5-Dimethylbenzene-1,3-disulfonamide	295, al		81, lgr		174, al							

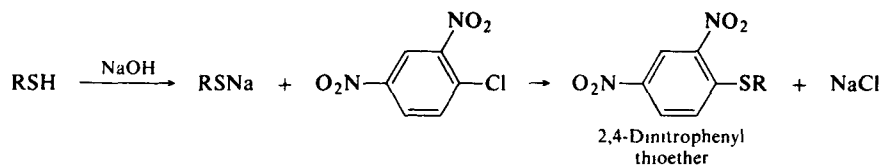
\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthylamide	S-Benzylthionium	p-Toluidinium	Anilinium	o-Toluidinium	
465	Naphthalene-1,6-disulfonamide	298	125 (anh)	129				81 (235)	314-5	298-9	323-4	
466	Naphthalene-1,7-disulfonamide	298 300	123									
467	Biphenyl-4,4'-disulfonamide	300	72	203				171	330 d			
468	Naphthalene-2,6-disulfonamide	305		225				256		360		
469	Azobenzene-3,3'-disulfonamide	305		<i>di</i> 166								
470	2,5-Dimethylbenzene-1,4-disulfonamide	310		164		223						
471	Naphthalene-1,5-disulfonamide	310 (340)	245 (anh)	183		249		257, 251 d	332			Di-Me ester, 205, chl
472	Benzene-1,3,5-trisulfonamide	310 5	>100	<i>tri</i> 187		<i>tri</i> 237						Tri-Et ester, 147, bz
473	Anthraquinone-2,6-disulfonilide	321		<i>di</i> 250, yel, chl bz								
474	Anthracene-1,5-disulfonamide	330		<i>di</i> 240		<i>di</i> 293						
475	Anthracene-1,8-disulfonamide	333		225		224						
476	8-Cyanonaphthalene-1-sulfonamide	333-4		139								
477	Anthraquinone-1,8-disulfonamide	>340	293 4	222 3, yel, PhNO <sub>2</sub>		237-8, yel, PhNO <sub>2</sub>						
478	Anthraquinone-1,3-disulfonamide	>350	310 11 (hyd)	265 70, yel		269-70, red-yel						

\*Derivative data given in order m p, crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE XXV

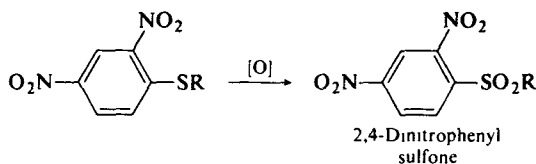
*2,4-Dinitrophenyl thioether (2,4-Dinitrophenyl sulfide).\**

From the sodium thiolate (prepared from the thiol and sodium hydroxide) and 2,4-dinitrochlorobenzene in methanol.

*For directions and examples see:* Cheronis, p. 642.

From the sodium thiolate and 2,4-dinitrochlorobenzene in aqueous or absolute alcohol.

*See:* Linstead, p. 86; Shriner, p. 255; Vogel, p. 500; Wild, p. 91; R. W. Bost, J. O. Turner and R. D. Norton, *J. Amer. Chem. Soc.*, **54**, 1985 (1932); R. W. Bost, J. O. Turner and M. W. Conn, *J. Amer. Chem. Soc.*, **55**, 4956 (1933).

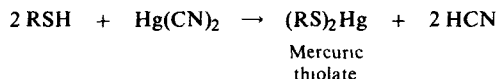
*2,4-Dinitrophenyl sulfone.\**

From the thioether (prepared from the thiol and 2,4-dinitrochlorobenzene) and potassium permanganate in aqueous or glacial acetic acid.

*For directions and examples see:* Cheronis, p. 641; Linstead, p. 87; Vogel, p. 501; Wild, pp. 91-2.

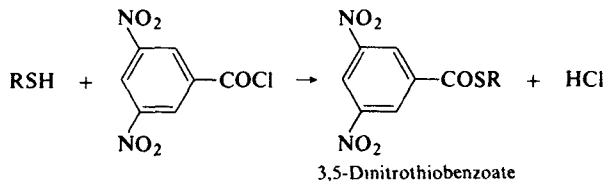
From the thioether with hydrogen peroxide, ammonium molybdate and perchloric acid in water.

*See:* Cheronis, p. 642.

*Hg salt.*

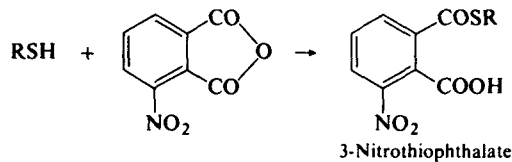
From the thiol and aqueous mercuric cyanide in ethanol.

*For directions and examples see:* Linstead, p. 86; Wild, pp. 90-91; E. Wertheim, *J. Amer. Chem. Soc.*, **51**, 3661 (1929).

*3,5-Dinitrothiobenzoate.\**

From the thiol, 3,5-dinitrobenzoyl chloride and pyridine.

*For directions and examples see:* Cheronis, p. 643; Shriner, p. 255; Vogel, p. 501; Wild, p. 92; E. Wertheim, *J. Amer. Chem. Soc.*, **51**, 3661 (1929).

*3-Nitrothiophthalate.\**

From 3-Nitrophthalic anhydride and the thiol.

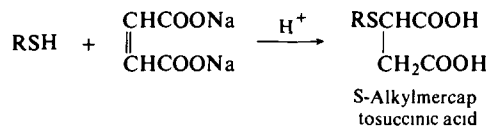
*For directions and examples see:* Wild, p. 93; E. Wertheim, *J. Amer. Chem. Soc.*, **51**, 3661 (1929).

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

EXPLANATIONS AND REFERENCES TO TABLE XXV (Continued)

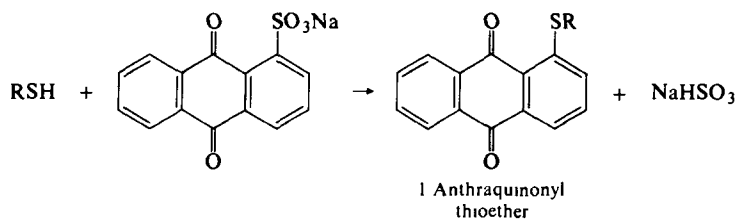
*S*-Alkylmercaptosuccinic acid (*Alkylthiosuccinic acid*) \*



From the thiol and disodium maleate in ethanol

For directions and examples see J G Hendrickson and L F Hatch, *J Org Chem*, **25**, 1747 (1960)

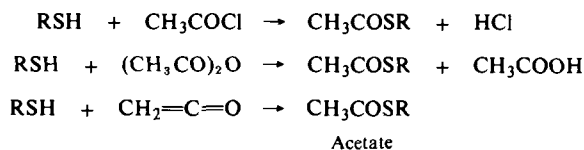
*1*-Anthraquinonyl thioether



From the thioether with sodium anthraquinone-1-sulfonate and sodium hydroxide in water

For directions and examples see E E Reid, C M MacKall and G E Miller, *J Amer Chem Soc*, **43**, 2104 (1921) W S Hoffman and E E Reid, *J Amer Chem Soc*, **45**, 1831 (1923) L M Ellis and E E Reid, *J Amer Chem Soc*, **54**, 1674 (1932)

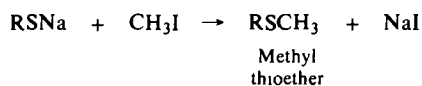
Acetate



From the thiol with acetyl chloride, or from the thiol with acetic anhydride and aqueous sodium hydroxide, or from the thiol with ketene

For directions and examples see A Schoberl and A Wagner in *Methoden der Organischen Chemie (Houben-Weyl)*, Vol 9 (Ed E Muller), Georg Thieme Verlag, Stuttgart, 1955, pp 753-756

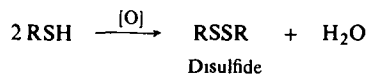
Methyl thioether



From the sodium thiolate with alkyl halide

For directions and examples see E E Reid, *The Chemistry of Bivalent Sulfur*, Vol 2, Chemical Publishing Co, New York, 1960, p 25

Disulfide



From the thiol (or thiophenol) with ferric chloride in aqueous acetic acid

For directions and examples see Linstead, p 87, Wild, p 95, T Zincke and W Frohneberg, *Chem Ber*, **43**, 840 (1910)

From the thiol with chlorine, bromine or iodine in hydrocarbon solvent

See E E Reid, *The Chemistry of Bivalent Sulfur*, Vol 1, Chemical Publishing Co, New York, 1958, p 124

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS)

a) Liquids (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	2,4-Di-nitro-phenyl thio-ether	2,4-Di-nitro-phenyl sulfone	3,5-Di-nitro-thio-benzoate	3 Nitro-thio-phthalate	1-An-thra-quinonyl thio-ether	Mercury salt	S Alkyl-mer-capto succinic acid	Disulfide	Miscellaneous
1	Methanethiol (Methyl mercaptan)	5 96	-123		0 8599 <sup>25</sup>	127 8	189 5			221	176	133	-84 72, b p 116 8	
2	Ethanethiol (Ethyl mercaptan)	36	-144 4	1 4318	0 83147 <sup>25</sup>	114-5	160	62	149	184	85	119 5	-101 4, b p 153 5	Acetyl, b p 114
3	2-Propanethiol (sec-Propyl mercaptan)	56	-130 7	1 4256	0 8142	93 5 5 0	140 5	84	145	134	63		-69 b p 176	
4	2-Methyl-2-propanethiol (tert-Butyl mercaptan)	64 2	1 26	1 4230	0 7999	109 11						164	b p 200 1	Benzoyl, b p 110 <sup>28</sup>
5	1-Propanethiol (n-Propyl mercaptan)	67 5	-113 8	1 4348	0 8047	85-6 5	127 5	52	137	151	72	118 9	-85 59 b p 195-6	
6	2-Butanethiol (sec-Butyl mercaptan)	84 5	-165 0	1 4367	0 8294	65 6 6 0	120				189	135	b p 95 7 <sup>14</sup>	Benzoyl, b p 150 <sup>20</sup>
7	2-Methyl-1-propanethiol (Isobutyl mercaptan)	88 72		1 4386	0 8357	74 5 5 0	105 5	63 4	136	144	95	120 9 1 4	b p 220	
8	2-Propene-1-thiol (Allyl mercaptan)	90 67 9		1 4680	0 93044	72	105	52					b p 174d	
9	1-Butanethiol (n-Butyl mercaptan)	98 100	-119 to -115	1 44402	0 8337	66	92	49	144	112 5	86	103 7-4 144 5	b p 226	Benzoyl, b p 160 <sup>23</sup>
10	2-Pentanethiol (sec-Amyl mercaptan)	112 9	-169	1 4386 <sup>25</sup>	0 82815 <sup>25</sup>								b p 122 3 <sup>10</sup>	
11	2-Methoxyethanethiol	113		1 4488 <sup>23</sup>		90								Acetyl, b p 110 <sup>110</sup>
12	D,L-3-Methylbutanethiol (Isoamyl mercaptan)	117 118 20		1 44118	0 83475							115 6-6 0	b p 250	
13	1-Phenylethane-1-thiol	119 20		1 557	1 022		161						58	Acetyl, b p 123-5 <sup>13</sup>
14	D-2-Methyl-1-butane-thiol	119 21			0 8403 <sup>25</sup>	78 9					60	122 3-6	b p 122 3	[ $\alpha$ ] <sub>D</sub> <sup>23</sup> +3 21
15	2-Chloropropanethiol	125		1 4844	1 1062	76 7							b p 113-20 <sup>20</sup>	Acetyl, b p 70-1 <sup>9</sup>
16	2-Chloroethanethiol	125-6		1 5289	1 203	95 7							b p 170 80	Acetyl, b p 51 <sup>4</sup>
17	2-Ethoxyethanethiol	125 6		1 5795	0 9462	66							b p 150-2 <sup>15</sup>	
18	1-Pentanethiol (n-Amyl mercaptan)	126 64	-75 83	1 44366	0 8390	79 5 80 5	83	40	132	114	75	107 8	b p 140-5 <sup>17</sup>	PdCl <sub>2</sub> deriv , 41
19	2-Hexanethiol (sec-Hexyl mercaptan)	142 138 9	-147 0	1 4426 <sup>25</sup>	0 83050 <sup>25</sup>									
20	1,2-Ethanedithiol (Ethylene dithio-glycol)	147, 46 7 <sup>16</sup>	-41 0	1 5550	1 1185 <sup>25</sup>	248								Di-Me eth , b p 183
21	1-Hexanethiol (n-Hexyl mercaptan)	151 2	-81 03	1 4490	0 8526	73 5 5 0	97			129	58	96 0- 5		
22	2-Hydroxyethanethiol	158, 54 <sup>12</sup>		1 4443	1 1143	100 2					123		28	Diacetyl, b p 98-9, Dibenzoyl, 39, S-Phenyl-urethane, 59-60, bz

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS)  
a) Liquids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Boiling point °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	2,4-Di-nitro-phenyl thio ether	2,4-Di-nitro-phenyl sulfone	3,5 Di-nitro-thioben-zoate	3 Nitro thio-phthal-ate	1-An-thra-quinonyl thio-ether	Mercury salt	S-Alkyl mer-capto succinic acid	Disulfide	Miscellaneous
23	Cyclohexanethiol (Cyclohexyl mercaptan)	158-60		1.4933	0.9782	148	172				78	150.5-1.5	b p 288	
24	<i>cis</i> -3-Methyl-1-cyclohexanethiol	165		1.4647 <sup>25</sup>	0.916 <sup>25</sup>									[ $\alpha$ ] <sub>531</sub> -2.24
25	Thiophenol (Mercaptobenzene)	169.5, 172.5	-14.9	1.5888	1.0780	121	161	149	131				66.5, 61	4-Nitro-thio-benzoyl, 115.7-8, Phenyl-urethane, 128
26	<i>trans</i> -3-Methyl-1-cyclohexanethiol	171		1.4663 <sup>25</sup>	0.914 <sup>25</sup>									[ $\alpha$ ] <sub>546</sub> +5.50
27	2-Thiophenethiol	171.1, 166		1.6021	1.168 <sup>19.5</sup>	119	143						56	Acetyl, b p 230.2
28	1,3-Propanedithiol	172.9	-79.0	1.5371 <sup>45</sup>	1.0775 <sup>25</sup>	194							b p 198 <sup>20</sup>	Diben-zoyl, 56.3
29	1-Heptanethiol ( <i>n</i> -Heptyl mercaptan)	176.7	-43.4	1.4498 <sup>25</sup>	0.83891 <sup>25</sup>	81-2	101	53	96	132	77	105.8-6.2	b p 164 <sup>6</sup>	
30	2-Octanethiol ( <i>sec</i> -Octyl mercaptan)	186.4	-79.0	1.4481 <sup>25</sup>	0.83293 <sup>25</sup>								b p 161-71 <sup>6</sup>	
31	2-Thiocresol (2-Toluenethiol)	194.3	15			101.98, 9.5	155					170.3		S-4-Nitro-benzoyl, 90-1
32	Phenylmethanethiol (Benzyl mercaptan)	194-5			1.058	130, 128.5-9.5	182.5	120	137			189-90, 192	74, 70	Ph eth, 42
33	3-Thiocresol (3-Toluenethiol)	195.4				100-1.5, 9.1	145							S-4-Nitro-benzoyl, 95-6, Ag deriv, 126-7
34	1,4-Butanedithiol	195.6	-53.9	1.5265 <sup>25</sup>	1.0395 <sup>25</sup>									Diben-zoyl, 49.5
35	2-Phenylethanethiol	199		1.5643 <sup>19</sup>	1.0318 <sup>15</sup>	93-4.5	133						b p 168-80 <sup>1.5</sup>	Acetyl, b p 134.5 <sup>14</sup>
36	1-Octanethiol ( <i>n</i> -Octyl mercaptan)	199.1	-49.2	1.4519 <sup>25</sup>	0.83956 <sup>25</sup>	78, 76-7.5	98			95	71	96.1-6	b p 178-83 <sup>5</sup>	
37	2-Chlorothiophenol	205			1.2752 <sup>19.5</sup>	138							90	
38	2,5-Dimethylthiophenol ( <i>p</i> -Xylene-2-thiol)	211-2												S-Ph eth, b p 172.5 <sup>11</sup> , S-4-Tolyl, eth, b p 188 <sup>11</sup>
39	2,4-Dimethylthiophenol ( <i>m</i> -Xylene-4-thiol)	214												S-Ph eth, b p 171 <sup>11</sup> , S-Benzyl eth, 35

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS)**  
**a) Liquids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	2,4-Di-nitro-phenyl thio ether	2,4-Di-nitro-phenyl sulfone	3,5 Di-nitro-thioben-zoate	3 Nitro-thio-phthal-ate	1-An-thra-quinonyl thio ether	Mercury salt	S-Alkyl mer-capto-succinic acid	Disulfide	Miscellaneous
40	2-Hydroxythiophenol (Thiocatechol)	216 77 <sup>51</sup> , 88 90 <sup>8</sup>	5-6		1 2373 <sup>9</sup>									O-Me eth , b p 218-9, Di-Me eth , b p 237
41	Bis(2-mercaptoethyl) ether	217	-80	1 5339	1 1648 <sup>25</sup>									4-Nitro-benzoyl, 106 5 Dibenzoyl, 45
42	1,5-Pentanedithiol	217 3, 110 <sup>16</sup>	-72 5											
43	1-Nonanethiol ( <i>n</i> -Nonyl mercaptan)	220 2	-20 1	1 45197	0 83714	86, 84 5	92			117 5		105-6	b p 211-2 <sup>6</sup>	
44	2-Isopropyl-5-methyl-benzenethiol (Thiothymol)	230-1										78, al		
45	5-Isopropyl-2-methyl-benzenethiol (Thiocarvacrol)	235-6			0 9975 <sup>17 3</sup>						109			S-Me eth , b p 244
46	1,6-Hexanedithiol	237 1	-21 0	1 5077 <sup>25</sup>	0 9886 <sup>25</sup>									Dibenzoyl, 57 Benzyl eth , 78-80, 4-Nitro-benzoyl, 121-30, Acetyl, b p , 200-3 <sup>25</sup>
47	1-Naphthalenethiol ( $\alpha$ -Mercapto naphthalene)	285, 114 8 <sup>10 3</sup>		1 6802	1 1607									

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS)  
b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point, °C	Boiling point °C	2,4-Di-nitro-phenyl thio-ether	2,4-Di-nitro-phenyl sulfone	Acetate	Benzoate	S-Alkyl mer-capto-succinic acid	Disulfide	Methyl thio-ether	Miscellaneous
1	3-Hydroxythiophenol (Thio-resorcinol)	17	168 <sup>15</sup>				<i>dt</i> 78		95	15 b p 224 sl d	Di-Me eth , b p 224-5
2	Hexadecanethiol (Cetyl mercaptan)	19	123-8 <sup>0 5</sup>	91, 96	105			105 6 5	55 5		
3	1,10-Decanedithiol	20 17 8	297 1				<i>dt</i> 57 55				D <sub>4</sub> <sup>5</sup> 0 9432 n <sub>6</sub> <sup>5</sup> 1 4940
4	Benzoylmethanethiol (2-Mercapto-acetophenone)	23 4	116 22 <sup>1</sup>						81		D <sub>4</sub> <sup>10</sup> 1 1753, Oxime, 70, Phenyl-hydrazone, 90 1
5	2-Aminothiophenol	26	234, 125-7 <sup>b</sup>	152		<i>dt</i> 135			93	b p 234 sl d	
6	3-Phenylenedithiol (Dithio-resorcinol)	27 1	245 123 <sup>11</sup>								Trinitrobenzene add comp , 76 7
7	4-Dimethylaminothiophenol	28 5	259 60	176					118		
8	2-Phenylenedithiol (Dithiocatechol)	29	238 9			<i>dt</i> 88 5	<i>dt</i> 74 5 94-5				
9	4-Hydroxybenzenethiol (Thio-hydroquinone)	30	144 6 <sup>20</sup>			S- 85 6, bz -lgr , <i>dt</i> 66	75, <i>dt</i> 161			84 5	S-Et eth , 39-41
10	<i>threo</i> -Dithiothreitol ( <i>threo</i> -2,3-Dihydroxy-1,4 dithiobutane)	42 3	123-5 <sup>2</sup>			<i>tetra</i> 73, me al					Oxid → <i>trans</i> -4,5-dihydroxy- <i>o</i> -dithiane, 132, Di-isopropylidene deriv 78, me al
11	4-Thiocresol (4-Toluenethiol)	43-4	195	102 5 4	189 5	<i>dt</i> 66	<i>dt</i> 161				S-4-Tolyl deriv , 57 S-4-Nitrobenzoyl 114 5 S-Chloro-acetyl, 40
12	4-Chloro-1-naphthalenethiol	43 4, al							122		
13	4-Aminothiophenol	46	140 5 <sup>16</sup>			N-mono 154 163, yel			82	b p 272 3	
14	1,4-(Dimethylthio)-benzene ( <i>p</i> -Xylylene dimercaptan)	46-7	156 <sup>12</sup>				<i>dt</i> 135				
15	5-Amino-2-methylthiophenol	47, bz - pet eth				<i>dt</i> 125, yel , bz - pet eth				147 lgr	Tri-Me eth , b p 159
16	4-Chlorothiophenol	54	123					163 4	73		
17	2-Hydroxy-1-naphthalenethiol	55, pet eth				O- 120, CCl <sub>4</sub> , <i>dt</i> 57					
18	1,3,5-Benzenetrithiol	57 60				<i>tri</i> 73-4, al				<i>tri</i> 66 8, al 64 5	
19	2-Nitrothiophenol	58 61		131 3					199		
20	1-Amino-2-propanethiol	63 5							Dihydro-chloride, 214		Hydrochloride, 87- 8, al Picrate, 143-4 d
21	4-Bromothiophenol	75	231	142	190	51 2, me al			94 5	38, al	Benzenesulfonate, 75
22	3-Nitrothiophenol	77							84		
23	4-Nitrothiophenol	77		160			123 7, 50 <sup>o</sup> <sub>n</sub> ac a		184	72	
24	4-Nitro-1-naphthalenethiol	77 9		193					189		
25	2-Naphthalenethiol (2-Mercapto-naphthalene)	81	286	145	228	53 5			139		4-Nitrobenzoyl, 183-4, 2-Tolyl eth , b p 229 5 <sup>11</sup>

\* Derivative data given in order m p , crystal color, solvent from which crystallized



TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS)

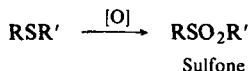
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	2,4-Di-nitro-phenyl thio-ether	2,4-Di-nitro-phenyl sulfone	Acetate	Benzoate	S-Alkyl mer-capto succinic acid	Disulfide	Methyl thio-ether	Miscellaneous
26	<b>DL-erythro-Dithiothreitol</b> ( <i>erythro</i> -2,3-Dihydroxy-1,4-dithiobutane)	82 3, lt pet eth				<i>tetra</i> 126, bz					Oxid → <i>cis</i> -4,5-di-hydroxy- <i>o</i> -di-thiane, 132 Di-iso-propylidene deriv., 145, pet eth
27	<b>4-Iodothiophenol</b>	85 6, al		140 5					124	45 38	CrO <sub>3</sub> /AcOH → sulfone, 83
28	<b>4-Amino-1-naphthalenethiol</b>	91 3				<i>N-mono</i> 173			168		
29	<b>2-(3-Aminopropionamido)ethane-thiol</b> (Alethene)	93 6, subl 140 <sup>10</sup> s				<i>di</i> 139 40, et ac					Hydrochloride, 214 7, 95 <sup>o</sup> , al. Oxalate, 121 2, al
30	<b>Bis(4-mercaptophenyl) ether</b>	98				<i>di</i> 68					
31	<b>4-Phenylenedithiol</b> (1,4-Dimer-captobenzene)	98, aq al				<i>di</i> 126, pet eth				<i>di</i> 85, me al	Di-Et eth, 81 5, al
32	<b>2-Aminoethanethiol</b>	98 100	130	94 5		<i>di</i> 30			Dihydro-chlo- ride, 216		Hydrochloride, 70 2, al. Picrate, 126 S-Acetyl hy- drochloride, 137
33	<b>Triphenylmethanethiol</b>	107		190		139-41	185		<i>ca</i> 155		
34	<b>4-Bromo-2-nitrothiophenol</b>	110		142							
35	<b>4-Biphenylthiol</b>	111 2, al		146	170				150	107 8, al	
36	<b>3-Amino-1-propanethiol</b>	112 3							Dihydro-chlo- ride, 219		Hydrochloride, 69, dil al
37	<b>1,8-Naphthalenedithiol</b>	113 4, al								<i>di</i> 84	
38	<b>4-Hydroxy-1-naphthalenethiol</b>	114				<i>di</i> 77					
39	<b>Bis(4-thiophenyl) sulfide</b>	114				<i>di</i> 65			190		
40	<b>2,4,6-Trinitrothiophenol</b>	114		217							
41	<b>1,5-Naphthalenedithiol</b>	118 21, yel				<i>di</i> 187-9	<i>di</i> 232			<i>di</i> 250	
42	<b>4-Chloro-2-nitrothiophenol</b>	120 2		141							
43	<b>2,4-Dinitrothiophenol</b>	131 2		193 7	240 1	107	113		280		
44	<b>6-Hydroxy-2-naphthalenethiol</b>	137, al				<i>di</i> 110, 107, al			221		
45	<b>2-Benzothiazolthiol</b>	177 9, aq me al								52, aq al	Et eth, 26 al
46	<b>2,7-Naphthalenedithiol</b>	181, 174, al				<i>di</i> 110	<i>di</i> 152-3				
47	<b>1-Antraquinonethiol</b>	187, yel, ac a							>350	218, yel, al	Et eth, 183, yel, al, Benzyl eth, 241, yel, ac a
48	<b>2-Antraquinonethiol</b>	206, yel, ac a							257	162, yel, ac a	Et eth, 138, yel, al, Benzyl eth, 138, yel, al Benzyl eth, 186 7, 1-N-Me eth, 190-2
49	<b>2-Benzimidazolthiol</b>	298, 296 7, dil al									

\*Derivative data given in order m p, crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE XXVI

## Sulfone \*



From the thioether in glacial acetic acid with dilute aqueous potassium permanganate

For directions and examples see Cheronis, p 641, Linstead, p 87, G W Fenton and C K Ingold, *J Chem Soc*, 2338 (1929), H Rheinboldt and E Giesbrecht, *J Amer Chem Soc*, 68, 973 (1946)

From the thioether with aqueous hydrogen peroxide in acetone or in acetic acid

See O Hinsberg, *J prakt Chem*, 90, 350 (1914), H Rheinboldt and E Giesbrecht, *J Amer Chem Soc*, 68, 973 (1946), C G Overberger, S P Lighthelm and E A Swire, *J Amer Chem Soc*, 72, 2856 (1950)

From the thioether with hydrogen peroxide and ammonium molybdate in aqueous perchloric acid

See Cheronis, p 641

From the thioether with potassium bichromate and sulfuric acid in water

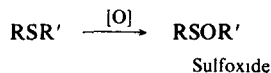
See G Raiziss, L W Clemence, M Severac and J C Moetsch, *J Amer Chem Soc*, 61, 2763 (1939)

From the thioether with chromic anhydride in glacial acetic acid

See C G Overberger, S P Lightelm and E A Swire, *J Amer Chem Soc*, 72, 2856 (1950)

For extensive lists of references for the oxidation of thioethers to the corresponding sulfones see A Schoberl and A Wagner in *Methoden der Organischen Chemie (Houben-Weyl)*, Vol 9, (Ed E Miller), Georg Thieme Verlag, Stuttgart, 1955, pp 227-231, E E Reid, *Organic Chemistry of Bivalent Sulfur*, Vol 2, Chemical Publishing Co, New York, 1960, pp 64-65

## Sulfoxide



From the thioether with hydrogen peroxide in acetic acid, in acetone or in alcohol-acetic acid mixture

For directions and examples see O Hinsberg, *Chem Ber*, 43, 289 (1910), R L Shriner, H C Struck and W V Jorison, *J Amer Chem Soc*, 52, 2060 (1930), P Karrer, N J Antia and R Schwyzer, *Helv chim Acta*, 34, 1392 (1951)

From the thioether with perphthalic acid in ether

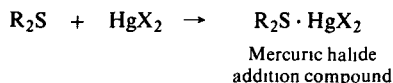
See H Bohme, *Chem Ber*, 70, 378 (1937)

From the thioether with chromic anhydride in aqueous acetic acid

See R Knoll, *J prakt Chem*, 113, 40 (1926)

For additional references for the oxidation of thioethers to the corresponding sulfoxides see A Schoberl and A Wagner in *Modern Methoden der Organischen Chemie (Houben-Weyl)*, Georg Thieme Verlag, Stuttgart, 1955, pp 211-215

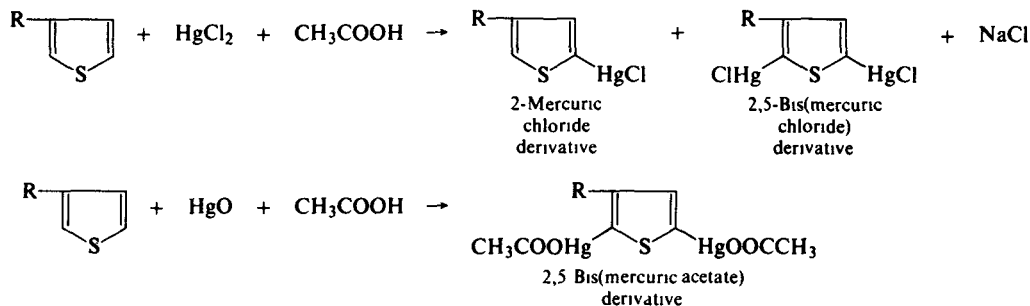
## Mercuric halide addition compound



From the thioether with mercuric chloride, bromide or iodide in ethanol, acetone or aqueous solution

For directions and examples see W F Faragher, J C Morrell and S Comay, *J Amer Chem Soc*, 51, 2774 (1929), E E Reid, *Organic Chemistry of Bivalent Sulfur*, Vol 2, Chemical Publishing Co, New York, 1960.

## Mercuric halide or mercuric acetate derivative



\*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLE XXVI (Continued)

*These derivatives are for substituted thiophenes only.*

From the substituted thiophene with the mercuric salt (with or without sodium acetate) in ethanol or in acetic acid.

*For directions and examples see: H. D. Hartough, Thiophene and its Derivatives, (The Chemistry of Heterocyclic Compounds, Vol. 3), Interscience, London, 1952, pp. 444-453.*

For various additional compounds of thioethers with metal salts *see: E. E. Reid, Organic Chemistry of Bivalent Sulfur, Vol. 2, Chemical Publishing Co., New York, 1960, pp. 52-60.*

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)

a) Liquids 1) Noncyclic (Listed in order of increasing b.p.)\*

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Sulfone	Sulfoxide	Disulfide	Miscellaneous
1	Dimethyl sulfide (Methyl sulfide)	37.3	-98.27	1.4356	0.8458 <sup>21</sup>	109 b p 238	18.45 b p 189	109.7	Tn-HgCl <sub>2</sub> , add comp., 158. 150. 1., rapid htng. HgI <sub>2</sub> , add comp., 75. SnBr <sub>4</sub> , add comp., 85-7. PtCl <sub>2</sub> , add comp., 159. PtBr <sub>4</sub> , add comp., 159. PdCl <sub>2</sub> , add comp., 130. PdBr <sub>2</sub> , add comp., 125. AgNO <sub>3</sub> , add comp., 126.
2	Ethyl methyl sulfide	66.9	-104.8	1.4353	0.8483	36, eth		130	HgCl <sub>2</sub> , add comp., 128. HgI <sub>2</sub> , add comp., 59. PdCl <sub>2</sub> , add comp., 67.
3	Methyl vinyl sulfide	67.3		1.4845	0.9026				
4	Divinyl sulfide (Vinyl sulfide)	84			0.9174				
5	Allyl methyl sulfide	91.3		1.4712	0.8767				
6	Diethyl sulfide (Ethyl sulfide)	92	-102.05	1.44233	0.8368	73.4 b p 248	4.6, 15 b p 88 9 <sup>15</sup>	152.6 154	Disulfoxide 123. 4 <sup>11</sup> . Mono-HgCl <sub>2</sub> , add comp., 90. Di-HgCl <sub>2</sub> , add comp., 119.5. HgI <sub>2</sub> , add comp., 110. AgNO <sub>3</sub> , add comp., 122. SnCl <sub>4</sub> , add comp., 102. SnBr <sub>4</sub> , add comp., 84. PtCl <sub>2</sub> , add comp., 106. PtBr <sub>2</sub> , add comp., 118. PtI <sub>2</sub> , add comp., 136. PdCl <sub>2</sub> , add comp., 83. PdBr <sub>2</sub> , add comp., 100.
7	Ethyl vinyl sulfide	92		1.4756	0.8756				
8	Isopropyl methyl sulfide	93.5, 85	-101.48	1.4392	0.8291				
9	Methyl <i>n</i> -propyl sulfide	95.5	-112.98	1.4442	0.8438				
10	<i>tert</i> -Butyl methyl sulfide	99		1.4402	0.8257				
11	Chloromethyl methyl sulfide	107.1		1.4967					
12	Ethyl isopropyl sulfide	107.3	-122.19	1.4407	0.8246				
13	Isobutyl methyl sulfide	112.5		1.4433	0.8335				
14	Methyl 2-methylallyl sulfide	113.0, 2		1.4712					
15	Allyl ethyl sulfide	115.6			0.8676				
16	Ethyl <i>n</i> -propyl sulfide	118.5, 110.2	-117.04	1.4461	0.84448	25. b p 142 <sup>23</sup>		173.7	
17	Di-isopropyl sulfide (isopropyl sulfide)	120.7	-78.08	1.4381	0.8135	36	68.5	176	PtCl <sub>2</sub> , add comp., 163. PtBr <sub>2</sub> , add comp., 174. PtI <sub>2</sub> , add comp., 176. PtI <sub>4</sub> , add comp., 139. HgCl <sub>2</sub> , add comp., 116.5.
18	<i>n</i> -Butyl methyl sulfide	122.5		1.4477	0.8427				
19	Chloromethyl ethyl sulfide	128				33		b p 78 80 <sup>16</sup>	
20	Isopropyl propyl sulfide	132		1.4440	0.8269				
21	<i>sec</i> -Butyl ethyl sulfide	133.6		1.4477	0.8353				
22	Ethyl isobutyl sulfide	134.2		1.4452	0.8306				
23	Diallyl sulfide (Allyl sulfide)	139 <sup>75K</sup> , 35 <sup>5-7</sup>	-83	1.4877 <sup>27</sup>	0.88765 <sup>27</sup>	b p 109 <sup>3</sup>	b p 107-97 <sup>a</sup>	b p 78 80 <sup>16</sup>	HgCl <sub>2</sub> , add comp., 108.
24	Methyl 2-methylbutyl sulfide	139-40			0.8410 <sup>19</sup>				
25	2-Chloroethyl methyl sulfide	140, 44 <sup>20</sup>		1.4908	1.1155				
26	Di- <i>n</i> -propyl sulfide ( <i>n</i> -Propyl sulfide)	141.2	-101.9	1.4481	0.8358	30	14.5, 5.0, b p 82 <sup>15</sup>	194	Mono-HgCl <sub>2</sub> , add comp., 88. 9. Di-HgCl <sub>2</sub> , add comp., 122. 127.5. Chloroamine-T → sulfilimide, 110. 15.
27	<i>n</i> -Butyl ethyl sulfide	144.2	-95.13	1.4491	0.8376	50		193	
28	Methyl pentyl sulfide (Amyl methyl sulfide)	144.5-5.5		1.448	0.843				HgCl <sub>2</sub> , add comp., 127.
29	Di- <i>tert</i> -butyl sulfide ( <i>tert</i> -Butyl sulfide)	150		1.4505				201, b p 88 <sup>21</sup>	
30	Diacetyl sulfide (Thioacetic anhydride)	155.8d, 63 <sup>20</sup>		1.4810 <sup>21</sup>	1.124				Reduction → acetaldehyde, b p 20. 2. 2,4-dinitrophenylhydrazine, 168.
31	Dichloromethyl sulfide (Chloromethyl sulfide)	156.5	-54, -37	1.5313	1.4065	70.5-2.0			
32	2-Chloroethyl ethyl sulfide	157, 63-5 <sup>17</sup>		1.06644	1.4878				

\*Derivative data given in order m p., crystal color, solvent from which crystallized

TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)

a) Liquids 1) Noncyclic (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Sulfone	Sulfoxide	Disulfide	Miscellaneous
33	2-Aminoisopropyl methyl sulfide	158				b p 140 <sup>4</sup>			
34	Ethyl 3-methylbutyl sulfide	160		1.4495	0.8349	13.5			HgCl <sub>2</sub> add comp, 87
35	4-Chlorophenyl methyl sulfide	170		1.6023 <sup>25</sup>	1.1224 <sup>25</sup>	57.8			
36	3-Aminopropyl methyl sulfide	170				44, b p 165.8 <sup>6</sup>	197		Hydrochloride, 136, Picrate, 127, Oxalate, 207d
37	Di-isobutyl sulfide (Isobutyl sulfide)	172.3		1.4463	0.8262	17, b p 265	68.5	215	Mono-HgCl <sub>2</sub> add comp, 116, Di-HgCl <sub>2</sub> add comp, 131, PtCl <sub>2</sub> add comp, (i) 83 (ii) 139, PtBr <sub>2</sub> add comp, 143.4, PtI <sub>2</sub> add comp, 187, PtCl <sub>4</sub> add comp, 162, AuCl <sub>3</sub> add comp, 87, PdCl <sub>2</sub> add comp, 95, PdBr <sub>2</sub> add comp, 140, PdI <sub>2</sub> add comp, 145
38	Di-2-methylallyl sulfide (2-Methylallyl sulfide)	173							
39	Chloromethyl dichloromethyl sulfide	177.2 <sup>753</sup>		1.5395	1.5258				
40	Dicrotyl sulfide (Crotyl sulfide)	186.5, 88.9 <sup>20</sup>		1.495 <sup>25</sup>	0.9032 <sup>0</sup>				
41	Di-n-butyl sulfide (n-Butyl sulfide)	188.0, 182.109.15 <sup>15</sup>	-79.7	1.45405	0.8386	44, resolidsifies at 32.5	33	231	Di-HgCl <sub>2</sub> add comp 113.110.5, PtBr <sub>2</sub> add comp 65, PtI <sub>2</sub> add comp 67, PdCl <sub>2</sub> add comp, 32, Pd(NO <sub>3</sub> ) <sub>2</sub> add comp, 166, AgNO <sub>3</sub> add comp 98
42	4-Aminobutyl methyl sulfide	188.90				42, b p 165 <sup>4</sup>			Hydrochloride, 153.4, acet. Picrate, 116.8
43	Di-dichloromethyl sulfide (Di-chloromethyl sulfide)	189.62.4 <sup>10</sup>		1.5464	1.6273				
44	Methyl phenyl sulfide	194-6.78-9 <sup>13</sup>		1.5870	1.0533 <sup>25</sup>	88, w			
45	2-Chloroethyl chloromethyl sulfide	194.5.77 <sup>10</sup>		1.5311	1.338				
46	Benzyl methyl sulfide	195.8		1.5550 <sup>25</sup>		127, w			
47	Ethyl phenyl sulfide	205, 200-2		1.5701 <sup>15</sup>	1.024 <sup>15</sup>	42, b p 160 <sup>12</sup>			PdCl <sub>2</sub> add comp, 140
48	Isopropyl phenyl sulfide	208		1.5468	0.9855				PdCl <sub>2</sub> add comp, 162
49	Methyl 4-tolyl sulfide	211.2, 104-5 <sup>20</sup>		1.57537 <sup>16</sup>	1.0302 <sup>16</sup>	89, bz-pet eth	50-4		
50	Di-(3-methylbutyl)sulfide (Isoamyl sulfide)	215.3		1.4471	0.8285	31, b p 295		250	PdCl <sub>2</sub> add comp, 95, PdBr <sub>2</sub> add comp, 133, PdI <sub>2</sub> add comp, 143, SnCl <sub>4</sub> add comp, 64, SnBr <sub>4</sub> add comp, 45.6
51	Allyl phenyl sulfide	215-8, 104-6 <sup>25</sup>		1.5760	1.0275				
52	Di-2-chloroethyl sulfide (2-Chloroethyl sulfide, Mustard gas, Yperite)	217	14.4	1.53125	1.2741	56, b p 183 <sup>20</sup>	109-11		
53	Phenyl propyl sulfide	219-20		1.5571	0.9995	44			PdCl <sub>2</sub> add comp, 91
54	Ethyl 4-tolyl sulfide	220.1		1.5568	1.0016 <sup>17.5</sup>	55.6			
55	Benzyl ethyl sulfide	222.3, 98-9 <sup>13</sup>				84			Mono-HgCl <sub>2</sub> add comp, 84, Di-HgCl <sub>2</sub> add comp, 142
56	3-Methylbutyl phenyl sulfide	240-2		1.5380	0.9681	36			PdCl <sub>2</sub> add comp, 97
57	2-Chloroethyl phenyl sulfide	245, 121 <sup>15</sup>		1.5838	1.1799	45			
58	2-Chloroethyl 4-tolyl sulfide	255-7, 150-2 <sup>20</sup>				78			
59	2-Hydroxyethyl 4-tolyl sulfide	282-3, 119.20 <sup>1</sup>				55			
60	Di-(3-tolyl)sulfide (m-Tolyl sulfide)	290, 174 <sup>12</sup>				94	b p 215 <sup>15</sup>	b p 150 d	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)**  
**a) Liquids 1) Noncyclic (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	Sulfone	Sulfoxide	Disulfide	Miscellaneous
61	Diphenyl sulfide (Phenyl sulfide)	296, 157-8 <sup>16 s</sup>	-21.5	1.6312	1.1160	128-9, b p 379	70.5	61	Disulfone of the disulfide, 193-4
62	Di-n-heptyl sulfide (n-Heptyl sulfide)	298				80			
63	4-Chlorophenyl phenyl sulfide	305-15d, 167-8 <sup>10</sup>				34, 90			
64	Phenyl 3-tolyl sulfide	309.5, 164.5 <sup>11</sup>	-6.5		1.0937 <sup>16</sup>				
65	Phenyl 2-tolyl sulfide	309.9, 300.5, 160.5 <sup>11</sup>			1.1012 <sup>15</sup>	81, al			
66	Phenyl 4-tolyl sulfide	311.5, 167.5 <sup>11</sup>	15.7		1.0900 <sup>10, 7</sup>	127-8 al			

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)

a) Liquids 2) Cyclic (Listed in order of increasing b.p.)\*

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Sulfone	HgCl <sub>2</sub> addition compound	Miscellaneous
1	Ethylene sulfide (Thiirane Thiacyclopropane)	55-6		1.4914	1.0046			Polymerizes rapidly
2	2-Methylethylene sulfide (2-Methylthiirane)	76		1.473 <sup>19</sup>	0.946 <sup>18</sup>			
3	Thiophene	84-12	-38-30	1.5287	1.0644			2-HgCl deriv., 182-3; 2-HgBr deriv., 169-70, 2-HgI deriv., 116-7
4	2,2-Dimethylethylene sulfide (2,2-Dimethylthiirane)	87, 84-6		1.4641				
5	Trimethylene sulfide (Thietane Thiacyclobutane)	95	-73-25	1.506 <sup>23</sup>	1.0200	76, w	93-5 d	Methodide, 98-5-9-0
6	2-Ethylethylene sulfide (2-Ethylthiirane)	104		1.475 <sup>19</sup>	0.930 <sup>18</sup>			
7	2-Methyltrimethylene sulfide (2-Methylthietane)	106		1.4831	0.9571	b p 251-5-3-5		
8	2-Methylthiophene	112-4		1.52042	1.02183			5-HgCl deriv., 204, 5-HgBr deriv., 179-80, 5-HgI deriv., 111-2
9	2,4-Dimethyltrimethylene sulfide (2,4-Dimethylthietane)	113-4		1.4502 <sup>18</sup>	0.8710 <sup>18</sup>	b p 255-0-5-5		
10	3-Methylthiophene	115-4		1.52042	1.02183			2-HgCl deriv., 128-9, 2,5-Di-HgOOCCH <sub>3</sub> deriv., >240d
11	2,2-Dimethyltrimethylenesulfide (2,2-Dimethylthietane)	120		1.4739 <sup>18</sup>		55	118	
12	Tetramethylene sulfide (Thiolane Thiophane Thiacyclopentane)	121-2, 120-2-5	-96-17	1.5047	0.99869	28-36	128	Sulfoxide, 105-7 <sup>12</sup>
13	2-Methyltetramethylene sulfide (2-Methylthiolane)	132-5 <sup>750</sup>	-100-71	1.4922	0.9555	b p 279-80 <sup>758</sup>	di 162	
14	2-Ethylthiophene	132-5-4-0		1.5127	0.990 <sup>24</sup>			5-HgCl deriv., 147-8, 5-HgI deriv., 96-7
15	3-Ethylthiophene	135-6		1.5146	0.9980			2-HgCl deriv., 67-8, 2,5-Di-HgCl deriv., 295-7d
16	2,5-Dimethylthiophene	135-5-6-0	-62-57	1.5126	0.98587			3-HgCl deriv., 156-7, 3-HgI deriv., 175
17	2,4-Dimethylthiophene	137-8, 140		1.5130	0.9956			5-HgCl deriv., 138-9, 5-HgI deriv., 137-9
18	3-Methyltetramethylene sulfide (3-Methylthiolane)	138-2	-81-10	1.4924	0.9634	1, 0-5	83	
19	2,3-Dimethylthiophene	140-2-1-2	-49-1 to -48-9	1.5188	1.0021			5-HgCl deriv., 218-5-9-5, 5-HgI deriv., 184-0-4-5, 4,5-Di-HgOOCCH <sub>3</sub> , 237-40
20	trans-2,5-Dimethyltetramethylene sulfide (trans-2,5-Dimethylthiolane)	142	-76-35	1.4766	0.9188	3, b p 278	111	
21	cis-2,5-Dimethyltetramethylene sulfide (cis-2,5-Dimethylthiolane)	142-3		1.4799	0.9222	4, b p 278	di 180	
22	3,4-Dimethylthiophene	144-6		1.5212	1.008 <sup>21</sup>			2-HgCl deriv., 139-40-5, 2-HgBr deriv., 152, 2-HgI deriv., 142
23	1,4-Thioxane	148-9	-17	1.5070	1.1177	130, 105-5	171	Sulfoxide, 25, 45
24	2-Methylpentamethylene sulfide (2-Methylthiane)	151	-58-14	1.4905	0.9428	68-5	102	
25	2-Isopropylthiophene	152		1.5037	0.9673			
26	3-Isopropylthiophene	155-7, 157		1.5052	0.9733			5-HgCl deriv., 137
27	3-Methylpentamethylene sulfide (3-Methylthiane)	157-8	-60-17	1.4922	0.9473	83	136	
28	2-Ethyltetramethylene sulfide (2-Ethylthiolane)	157-8		1.4896	0.9451		mono 100, di 146-8	
29	2-Propylthiophene	157-5-9-5		1.5048	0.9683			5-HgCl deriv., 155, 5-HgSCN deriv., 169-0-9-5
30	4-Methylpentamethylene sulfide (4-Methylthiane)	158-6	-28-11	1.5049	0.9687	121-5	136	
31	2-Ethyl-5-methylthiophene	159-8-60-4	-68-6	1.5073	0.9663			

\* Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)  
a) Liquids 2) Cyclic (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	Sulfone	HgCl <sub>2</sub> addition compound	Miscellaneous
32	2-Ethyl-3-methylthiophene	160 0 1 5		1 5092 <sup>22</sup>	0 9792 <sup>22</sup>			5 HgCl deriv , 172-3, 5-Hgl deriv , 156-7
33	2,6-Dimethyl-1,4-thioxane	160 1		1 4733		105 5		
34	3-Propylthiophene	160 2		1 5057	0 9716			
35	2-Allylthiophene	161, 158 5 9 0		1 5281 <sup>20</sup>	1 0175 <sup>20</sup>			
36	3,5-Dimethyl-1,4-thioxane	162				102		
37	3-Ethyl-5-methylthiophene	162 4	-60 to -59	1 5098	0 9742			
38	2,3,5-Trimethylthiophene	163 5, 164 5 <sup>16</sup>		1 5131	0 9753			x-HgCl deriv , 160-1
39	2-tert-Butylthiophene	163 9	-59 2	1 49788	0 9514			
40	3-tert-Butylthiophene	168 9	-54 8	1 50149	0 9574			
41	Hexamethylene sulfide (Thiepane Thiacycloheptane)	170 173 4		1 5125	0 9883	71	149	Methiodide, 141 5-2 0
42	2,3,4-Trimethylthiophene	172 7, 160 3		1 5208	0 995			
43	1,3-Dithiolane(1,3-Dithiacyclopentane)	175		1 5975 <sup>13</sup>	1 259 <sup>1</sup>	di 205	117, 126	Methiodide, 96, Disulf-oxide, 134
44	2-Methyl-5-propylthiophene	179 5 80 5		1 5026				
45	Cyclohexene sulfide (7-Thiabicycloheptane)	180 71 5-3 5 <sup>21</sup>		1 5309	0 9274			
46	2-n-Butylthiophene	181-2 <sup>710</sup>		1 50896	0 9537			
47	2,5-Diethylthiophene	181-2, 63-6 <sup>14</sup>		1 5036	0 962 <sup>14</sup>			
48	3-n-Butylthiophene	181 3		1 51005	0 9570			
49	2,3,4,5-Tetramethylthiophene	182 4, 187 9		1 5196	0 9442 <sup>21</sup>			
50	3,4-Diethylthiophene	185-7		1 5157 <sup>17</sup>				2-HgCl deriv , 118
51	2-Ethyl-1,3-dithiolane	191 2				124		
52	2,4-Dimethyltetramethylene sulfide (2,4-Dimethylthiolane)	197 8 <sup>12</sup>		1 4818	0 9265	b p 123 3 <sup>5</sup>	89	
53	3-Ethyl-2,4,5-trimethylthiophene	204 6 <sup>748</sup>		1 5132	0 9609			
54	2-n-Octylthiophene	257 9, 106 8 <sup>1</sup>		1 4824	0 920			

\* Derivative data given in order m p , crystal color, solvent from which crystallized



TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)  
b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point °C	Boiling point °C	Sulfone	Sulfoxide	Disulfide	Miscellaneous
1	Ethyl 2-naphthyl sulfide	16	170.5 <sup>15</sup>	43.5			
2	Ethyl hexadecyl sulfide	19		88			
3	Thiane (Pentamethylene sulfide Thiacyclohexane)	19.07, 13	142	98.5, 9.0			D <sub>4</sub> <sup>10</sup> 0.9849, n <sub>D</sub> <sup>20</sup> 1.5067, HgCl <sub>2</sub> add comp., 137.5, al., Meth iodide, 192 subl
4	2-Methyl-1,4-dithiane	20		dt 304			
5	Didecyl sulfide (Decyl sulfide)	27	217.8 <sup>a</sup>	206.7			
6	3-Tolyl 4-tolyl sulfide	27.8, al	179 <sup>11</sup>	116, ac, a	72		
7	Diundecyl sulfide (Undecyl sulfide <i>n</i> -Hendecyl sulfide)	34.8					
8	Di-(2-bromoethyl)sulfide (Bromoethyl sulfide)	35		111.2			
9	4-Iodophenyl phenyl sulfide (4-Iododiphenyl sulfide)	35		141			
10	2-Aminophenyl phenyl sulfide (2-Aminodiphenyl sulfide)	35.6, al	212 <sup>22</sup>	122, dil, al			<i>N</i> -Benzenesulfonyl, 225.6
11	4-Bromophenyl methyl sulfide	37.5		56.7			
12	Didodecyl sulfide ( <i>n</i> -Dodecyl sulfide)	40.5				34.5	
13	Benzyl phenyl sulfide	41.44.5, al	197 <sup>2</sup>	146.6.5, 148, al	123		
14	Di-(4-chlorobenzyl)sulfide (4-Chlorobenzyl sulfide)	41				59	
15	1-Naphthyl phenyl sulfide	41.8, aq, al	220.5 <sup>11</sup>	99.5, 100.5, al			
16	3-Nitrophenyl phenyl sulfide (3-Nitrodiphenyl sulfide)	42.5		80.5, 81			
17	Ethyl 4-nitrophenyl sulfide	44		138.5			
18	Isopropyl 4-nitrophenyl sulfide	44.5		115.3			
19	Di-(4-methoxyphenyl)sulfide (4-Methoxyphenyl sulfide)	46		130	96	45	Disulfone, 221, r h 210.2, s h
20	Dibenzoyl sulfide (Thiobenzoic anhydride, Benzoyl sulfide)	48, al				133, 128	
21	Dibenzyl sulfide (Benzyl sulfide)	50, chl		151.7, al, bz	134.8	73	D <sub>4</sub> <sup>10</sup> 1.0712, HgCl <sub>2</sub> add comp., 131, HgI <sub>2</sub> add comp., 37.8, FeCl <sub>3</sub> add comp., 94, PtCl <sub>4</sub> add comp., 159, PtCl <sub>2</sub> add comp., 172d, PtBr <sub>2</sub> add comp., 139, PtI <sub>2</sub> add comp., 129
22	2,5-Dichlorophenyl methyl sulfide	51		88			
23	Methyl 2-naphthyl sulfide	51.8, 64	226 <sup>11</sup>	115.6, al	67.5		Disulfone, 166
24	Bis(phenylthio)methane	52		dt 120-1			
25	Ditetradecyl sulfide ( <i>n</i> -Tetradecyl sulfide)	53.8				46	
26	Di-(2-diphenoxylethyl)sulfide	54, al		108, pink, al		97	
27	1,3-Dithiane	54		dt 330, 308			
28	Bis(benzylthio)methane	55		dt 216			
29	4-Nitrophenyl phenyl sulfide (4-Nitrodiphenyl sulfide)	55, yel, lgr	240 <sup>25</sup>	142, aq, al			
30	Di- <i>n</i> -octyl sulfide ( <i>n</i> -Octyl sulfide)	57		76		b p 178-83 <sup>5</sup>	
31	Di-(4-tolyl)sulfide (4-Tolyl sulfide)	57.3	179 <sup>11</sup>	158, bz	95, pet, eth	48, al	
32	2-Aminophenyl 4-aminophenyl sulfide (2,4'-Diaminodiphenyl sulfide)	61, 62.5, aq, al		124-6			Diacetyl, 208
33	Dihexadecyl sulfide ( <i>n</i> -Hexadecyl sulfide)	61.3		103.4	99.8		
34	2-Chloroethyl 4-nitrophenyl sulfide	62		128			
35	Di-(2-tolyl)sulfide (2-Tolyl sulfide)	64, al	285, 174 <sup>15</sup>	134.5, al	121, pet, eth	38-9, al	
36	Methyl 2-nitrophenyl sulfide	64.5, yel, al		106			D <sub>4</sub> <sup>10</sup> 1.2626, n <sub>D</sub> <sup>20</sup> 1.62458, AgNO <sub>3</sub> add comp., 122, yel, al
37	Benzyl 4-bromophenyl sulfide	65		159			

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point, °C	Sulfone	Sulfoxide	Disulfide	Miscellaneous
38	1,2-Bis(phenylthio)ethane	69-70		di 180			
39	Diocetyl sulfide (Octadecyl sulfide)	71, 64-5				62-5	
40	2-Phenyl-1,3-dithiane	71-2		di 265			
41	Methyl 4-nitrophenyl sulfide	72		141			
42	Di-(3-phenylpropyl)sulfide (3-Phenylpropyl sulfide)	73		117		b p 165-6 <sup>o</sup> 03	D <sub>4</sub> <sup>80</sup> 1 2391, n <sub>D</sub> <sup>80</sup> 1 64008
43	Di-(2-methoxyphenyl)sulfide (2-Anisyl sulfide)	73, al	252-3 <sup>10</sup>	157-8, bz		120	
44	Di-(4-methylbenzyl)sulfide (4-Methylbenzyl sulfide)	76		197			
45	Cinnamyl phenyl sulfide	78		111-2	90-1		
46	4-(Methylthio)benzaldehyde	78, yel, lgr	273, 153 <sup>17</sup>				Phenylhydrazone, 138, Thiosemicarbazone, 177-9, yel
47	4-Nitrobenzyl phenyl sulfide	79		209-5			
48	1,2-Bis(tolylthio)ethane	80-1		di 200-1			
49	2-Nitrophenyl phenyl sulfide (2-Nitrodiphenyl sulfide)	80-2, 77, yel	210 <sup>15</sup>	147-5, al			
50	Di-(2-aminobenzyl)sulfide	81				90-1 lgr et ac	N,N'-Di-formyl, 163 N,N'-Diacetyl, 209 Picrate, 203-4d
51	4-Nitrophenyl 4-tolyl sulfide	81-5, yel		170-1, yel			
52	Di-(2-aminophenyl)sulfide	87		146-7		93, al	N,N'-Diacetyl, 164-5 N,N'-Dibenzoyl, 162-3
53	Di-(2-phenylethyl)sulfide (2-Phenylethyl sulfide)	92-5-90		100-6	69	b p 172-5 <sup>o</sup> *	
54	4-Aminophenyl phenyl sulfide (4-Amino-diphenyl sulfide)	96, lgr	243 <sup>29</sup>	176, al	152, w		Hydrochloride, 197-8d N-4-Toluenesulfonyl, 73
55	Di-(4-amino-3-methylphenyl)sulfide	96-25 <sup>o</sup> , al					Dihydrochloride, 248-9 dil HCl N,N'-Diacetyl, 22, al, N,N'-Dibenzoyl, 233, me al, Dipicrate, 186, w
56	Di-(4-chlorophenyl)sulfide (4-Chlorophenyl sulfide)	98-88-90	212 <sup>1*</sup>	148-9, subl	143	73	
57	3-Aminophenyl 4-nitrophenyl sulfide (3-Amino-4'-nitrodiphenyl sulfide)	99-100					N-Acetyl, 115-6, N,N-Dimethyl, 83-4
58	Di-(2-amino-5-methylphenyl)sulfide	103-4, al				98	Dihydrochloride, 100d, al, N,N'-Diacetyl, 165, al, N,N'-Dibenzoyl, 185-6, al, Diurethane, 113, bz-pet eth Dipicrate, 179, bz
59	Di-(4-aminobenzyl)sulfide	104-5				96-8, al	N,N'-Diacetyl, 188, N,N'-Dibenzoyl, 224
60	Di-(4-aminophenyl)sulfide	108-9, w		178, me al	175d, al	85-106, al	N,N'-Diacetyl, 220-1 N,N'-Dibenzoyl, 234
61	Di-(1-naphthyl)sulfide	110, al	290 <sup>15</sup>	187, al	166, al	91	
62	1,4-Dithiane	111-2	199-200	mono 200, di >330			Methodide, 73-4, Sulfoxide-sulfone, 279
63	Di-(4-bromophenyl)sulfide (4-Bromophenyl sulfide)	112, al	243 <sup>20</sup>	172	153, al	94-5	
64	2,4-Dinitrophenyl phenyl sulfide (2,4-Dinitrodiphenyl sulfide)	121, 117, bz		161			
65	Di-(2-nitrophenyl)sulfide (2-Nitrophenyl sulfide)	122-3, yel, al-ac a		164		198-9, ac a or bz	
66	Benzyl 4-nitrophenyl sulfide	123		172			
67	Di-(3-hydroxyphenyl)sulfide (3-Hydroxyphenyl sulfide)	130		190-1, 186-7	94-5, pet eth	95	Acetyl, 87
68	1,3-Bis(2-nitrophenylthio)propane	140		di 156-7			
69	Di-(2-hydroxyphenyl)sulfide (2-Hydroxyphenyl sulfide)	142, bz		179, 164-5, bz		b p >200d	Diacetyl, 95-6, al Di-Me eth, 73
70	1-Naphthyl 2-naphthyl sulfide (1,2'-Dinaphthyl sulfide)	151	291-2 <sup>15</sup>	123			
71	Di-(2-naphthyl)sulfide (2-Naphthyl sulfide)	151	296 <sup>15</sup>	177, al	137-5-8-5	139	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

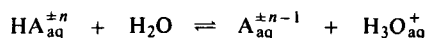
**TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point, °C	Sulfone	Sulfoxide	Disulfide	Miscellaneous
72	<b>Di-(4-hydroxyphenyl)sulfide</b> (4-Hydroxyphenyl sulfide)	151, al		240 l, w	195, acet	150 l	Diacetyl, 94-55, Di-Me eth, 46, Di-Et eth 55
73	<b>Di-(4-nitrobenzyl)sulfide</b> (4-Nitrobenzyl sulfide)	158-9		260-5	212	126-5	
74	<b>Di-(4-nitrophenyl)sulfide</b> (4-Nitrophenyl sulfide)	174-5, 156-7, or, or pale yellow		282, 245-225		182, acet	
75	<b>Di-(3-nitrophenyl)sulfide</b> (3-Nitrophenyl sulfide)	193		201		84, al	
76	<b>Di-(2,4-dinitrophenyl)sulfide</b> (2,4-Dinitrophenyl sulfide)	193-7-193-4, yellow, acet		240-1		280	
77	<b>Di-(2,4,6-trinitrophenyl)sulfide</b> (Dipicryl sulfide)	230-1-226, yellow		307			

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLES XXVII, XXVIII AND XXIX

The dissociation of an organic carboxylic acid, phenol or the conjugate acid of an amine in aqueous solution is expressed by the equation



and the corresponding equilibrium constant  $K_e$  is given by

$$K_e = \frac{(a_{\text{A}_{\text{aq}}^{\pm n-1}})(a_{\text{H}_3\text{O}^+})}{(a_{\text{HA}_{\text{aq}}^{\pm n}})(a_{\text{H}_2\text{O}})}$$

where the  $a$ 's are the activities of the species. At low electrolyte concentrations  $a_{\text{H}_2\text{O}}$  is virtually constant, and a second constant,  $K_a$ , the thermodynamic dissociation constant, is defined as

$$K_a = K_e(a_{\text{H}_2\text{O}}) = \frac{(a_{\text{A}_{\text{aq}}^{\pm n-1}})(a_{\text{H}_3\text{O}^+})}{(a_{\text{HA}_{\text{aq}}^{\pm n}})} = \frac{(c_{\text{A}_{\text{aq}}^{\pm n-1}})(c_{\text{H}_3\text{O}^+})}{(c_{\text{HA}_{\text{aq}}^{\pm n}})} \cdot \frac{f_{\pm}^2}{f_{\text{HA}_{\text{aq}}^{\pm n}}}$$

where the  $c$ 's are the concentrations and the  $f$ 's are the activity coefficients of the species

The dissociation constants in the Tables are given in the more convenient  $pK_a$  notation, where

$$pK_a = -\log K_a$$

For Table XXVII,  $\text{HA}^{\pm n} = \text{RCOOH}$ , and  $\text{A}^{\pm n-1} = \text{RCOO}^-$

For Table XXVIII,  $\text{HA}^{\pm n} = \text{ArOH}$ , and  $\text{A}^{\pm n-1} = \text{ArO}^-$

For Table XXIX,  $\text{HA}^{\pm n} = \text{RR}'\text{R}''\text{NH}^+$  and  $\text{A}^{\pm n-1} = \text{RR}'\text{R}''\text{N}$  ( $\text{R}$ ,  $\text{R}'$  and  $\text{R}''$  may be alkyl or aryl groups or a hydrogen atom)

For monobasic acids  $pK_a = pK_1$

For dicarboxylic acids both  $pK_1$  and  $pK_2$  are given,  $pK_1$  is defined above, and  $pK_2$  is the analogous dissociation constant of the monoanion,  $\text{A}^{\pm n-1}$ , obtained on the first dissociation. For other dibasic acids such as the conjugate acids of amino acids, or diamines,  $pK_1$  is as defined above, and  $pK_2$  is the dissociation constant for the species obtained after the first protonation.

For a comprehensive compilation of the dissociation constants of organic acids (including phenols) in aqueous solution, as well as summary of the methods for  $pK$  determinations, see G Kortum, W Vogel and K Andrussov, in *Pure and Applied Chemistry*, Vol 1, Butterworths, London, 1961, pp 190-536

For a comprehensive compilation of the dissociation constants of organic bases (especially amines) in aqueous solution see D D Perrin, *Dissociation Constants of Organic Bases in Aqueous Solution*, Butterworths, London, 1965

For general references including methods of determination of  $pK$ , and data for both acids and bases see J F King, in *Elucidation of Structures by Physical and Chemical Methods*, Vol 1 (Ed K W Bentley) (*Technique of Organic Chemistry*, Vol 9), Interscience, New York, 1963, Chapter 6, pp 318-401, H C Brown, D H McDaniel and O Hafiger in *Determination of Organic Structures by Physical Methods*, Vol 1 (Ed E A Braude and F C Nachod), Academic Press, New York, 1955, Chapter 14, p 567

\*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives

**TABLE XXVII. ACID DISSOCIATION CONSTANTS OF  
ORGANIC ACIDS IN AQUEOUS SOLUTION  
(Listed in order of increasing pKa)**

No	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>
1	Heptafluoro- <i>n</i> -butyric acid	25	0.17		51	1,3,5-Benzenetricarboxylic acid	25	2.12	3.89
2	Trifluoroacetic acid	25	0.23						pK <sub>3</sub> = 4.70
3	Trichloroacetic acid	25	0.63		52	D,L-3,5-Di-iodotyrosine	25	2.12	6.48
4	2,4,6-Trinitrobenzoic acid	25	0.65		53	3-(2-Fluorophenyl)alanine	24	2.12	9.01
5	Tribromoacetic acid	25	0.66		54	3-(4-Fluorophenyl)alanine	24	2.13	9.05
6	3-Chlorophenylglycine	25	1.05	3.93	55	D,L-β-Phenylalanine	25	2.16	9.15
7	2,6-Dinitrobenzoic acid	25	1.14		56	<i>l</i> -Lysine	25	2.16	9.18
8	Trichloroacrylic acid	25	1.15						pK <sub>3</sub> = 10.79
9	Difluoroacetic acid	25	1.24		57	<i>d</i> -Lysine	25	2.16	9.16
10	Oxalic acid	25	1.27	4.28					pK <sub>3</sub> = 10.81
11	Dichloroacetic acid	25	1.29		58	Glutamic acid	20	2.16	4.324
12	2-Chloro-6-nitrobenzoic acid	25	1.34						pK <sub>3</sub> = 9.96
13	2-Bromo-6-nitrobenzoic acid	25	1.37		59	6,6,6-Trifluoronorleucine	25	2.164	9.463
14	Benzenhexacarboxylic acid	25	1.40	2.19	60	3-(3-Chlorophenyl)alanine	25	2.17	8.91
				pK <sub>3</sub> = 3.31	61	2-Chloro-5-nitrobenzoic acid	25	2.17	
				pK <sub>4</sub> = 4.78	62	D,L-Serine	25	2.21	4.15
				pK <sub>5</sub> = 5.89	63	Diethylmalonic acid	25	2.21	7.29
				pK <sub>6</sub> = 6.96	64	<i>N</i> -Propylalanine	25	2.21	10.19
15	<i>d,l</i> -2,3-Dibromosuccinic acid	20	1.42	3.24	65	<i>N</i> -Ethylalanine	25	2.22	10.22
16	2,4-Dinitrobenzoic acid	25	1.42		66	D,L- <i>N</i> -Methylalanine	25	2.22	10.19
17	<i>erythro</i> -2-Bromo-3-chlorosuccinic acid	19	1.43	2.60	67	2-Nitrobenzoic acid	25	2.22	
18	<i>d,l</i> -2,3-Dichlorosuccinic acid	20	1.46	2.86	68	3-(2-Chlorophenyl)alanine	25	2.23	8.94
19	<i>threo</i> -2-Bromo-3-chlorosuccinic acid	20	1.46	2.77	69	6-Bromo-2-methylolbenzoic acid	20	2.25	
20	<i>meso</i> -2,3-Dibromosuccinic acid	20	1.51	2.71	70	6-Chloro-2-methylolbenzoic acid	20	2.26	
21	<i>meso</i> -2,3-Dichlorosuccinic acid	20	1.52	2.94	71	<i>d,l</i> -Valine	25	2.286	9.744
22	4,4,4-Trifluorovaline	25	1.537	8.098	72	<i>d,l</i> -2-Aminobutyric acid	25	2.29	9.83
23	4,4,4-Trifluorothreonine	25	1.554	7.822	73	2-Benzyl-2-cyanopropionic acid	25	2.29	
24	2-Amino-4,4,4-trifluoro- <i>n</i> -butyric acid	25	1.600	8.169	74	2-Amino- <i>n</i> -pentanoic acid	25	2.318	9.808
25	2,5-Dinitrobenzoic acid	25	1.62		75	(3,4-Dihydroxyphenyl)alanine	25	2.32	8.68
26	Nitroacetic acid	25	1.68						pK <sub>3</sub> = 9.88
27	Trifluoroacrylic acid	25	1.79		76	2-Chloro-3-hydroxysuccinic acid	25	2.32	
28	Benzenepentacarboxylic acid	25	1.80	2.73	77	3-Hydroxyglutaric acid	25	2.32	4.24
				pK <sub>3</sub> = 3.97					pK <sub>3</sub> = 9.56
				pK <sub>4</sub> = 5.25	78	<i>d,l</i> -Leucine	25	2.32	9.74
				pK <sub>5</sub> = 6.46	79	<i>d,l</i> -Norleucine	25	2.335	9.83
29	Cyclopropane-1,1-dicarboxylic acid	25	1.82	5.43	80	<i>d,l</i> -Alanine	25	2.34	9.87
30	Hydroxyproline	25	1.82	9.66	81	<i>cis</i> -Caronic acid ( <i>cis</i> -1,1-Dimethyl-2,3-cyclopropanedicarboxylic acid)	25	2.34	8.31
31	DL-Histidine	25	1.82	6.04					
				pK <sub>3</sub> = 9.12	82	<i>N</i> -Ethylglycine	25	2.34	10.23
32	2,3-Dinitrobenzoic acid	25	1.85		83	Glycine	25	2.35	9.78
33	2-Methyl-4-nitrobenzoic acid	25	1.86		84	<i>N</i> -Methylglycine	25	2.35	10.18
34	1,2,4,5-Benzenetetracarboxylic acid	25	1.92	2.87	85	<i>N</i> -Propylglycine	25	2.35	10.19
				pK <sub>3</sub> = 4.49	86	<i>N-n</i> -Butylglycine	25	2.35	10.25
				pK <sub>4</sub> = 5.63	87	<i>N</i> -Isobutylglycine	25	2.35	10.12
35	<i>trans</i> -Ethylene oxide-1,2-dicarboxylic acid	19	1.93	3.25	88	2-Aminoisobutyric acid	25	2.36	10.25
36	<i>cis</i> -Ethylene oxide-1,2-dicarboxylic acid	18	1.94	3.92	89	(Methylsulfonyl)acetic acid	25	2.36	
37	Maleic acid	25	1.94	6.23	90	2-Cyano-2-cyclohexylacetic acid	25	2.37	
38	Ornithine	25	1.94	8.65	91	2-Cyanopropionic acid	25	2.37	
39	2-Chloro-4-nitrobenzoic acid	25	1.96		92	D,L-Tryptophane	25	2.38	9.39
40	4-Aminosalicylic acid (4-Amino-2-hydroxybenzoic acid)	25	1.99	3.92	93	1,2,3,5-Benzenetetracarboxylic acid	25	2.38	3.51
41	2-Chloro-3-nitrobenzoic acid	25	2.02						pK <sub>2</sub> = 4.44
42	Asparagine	25	2.05	3.87					pK <sub>3</sub> = 5.81
43	Anthranilic acid	25	2.05	4.95	94	4-Aminobenzoic acid	25	2.38	
44	5,5,5-Trifluoroleucine	25	2.05	8.92	95	2-Cyanoisobutyric acid	25	2.42	
45	S-Ethylcysteine	25	2.05	8.60	96	Cyanoacetic acid	25	2.46	
46	1,2,3,4-Benzenetetracarboxylic acid	25	2.06	3.25	97	Pyruvic acid	25	2.49	
				pK <sub>3</sub> = 4.73	98	O-Acetylcitric acid	25	2.49	
				pK <sub>4</sub> = 6.21	99	3-Pentenoic acid	25	2.51	
47	Di- <i>n</i> -propylmalonic acid	25	2.07	7.51	100	1,2,4-Benzenetricarboxylic acid	25	2.52	3.84
48	3-(4-Chlorophenyl)alanine	25	2.08	8.96					pK <sub>3</sub> = 5.20
49	3-(3-Fluorophenyl)alanine	24	2.10	8.98	101	(2-Chlorovinyl)acetic acid	25	2.54	
50	Arginine	25	2.10	9.07	102	Oxaloacetic acid	25	2.55	4.37
					103	Fluoroacetic acid	25	2.58	

TABLE XXVII. ACID DISSOCIATION CONSTANTS OF ORGANIC ACIDS IN AQUEOUS SOLUTION (Listed in order of increasing pK<sub>a</sub>) (Continued)

No	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>
104	Phenylmalonic acid	25	2.58	5.03	162	(2,4-Dichloro-6-methylphenoxy)acetic acid	20	3.13	
105	2-Chloro-3-hydroxybutyric acid	25	2.58		163	2-Cyanobenzoic acid	25	3.14	
106	2-Fluoroacrylic acid	25	2.58		164	(3-Methoxyphenoxy)acetic acid	25	3.14	
107	2,4-Dioxo- <i>n</i> -pentanoic acid	25	2.58		165	Ethyl- <i>n</i> -propylmalonic acid	25	3.15	7.43
108	2-Chloro-3-hydroxy-3-phenylpropionic acid	25	2.61		166	4,4,4-Trifluorocrotonic acid	25	3.15	
109	2-Chloro-6-hydroxybenzoic acid	25	2.63		167	(4-Iodophenoxy)acetic acid	25	3.16	
110	2-Butynoic acid (Tetrolic acid)	25	2.65		168	(2-Iodophenoxy)acetic acid	25	3.17	
111	1-Aminocyclohexanecarboxylic acid	25	2.66		169	3,3-Difluoroacrylic acid	25	3.17	
112	Bromosuccinic acid	50	2.69	4.69	170	Dimethylmalonic acid	25	3.17	6.06
113	3-Hydroxy-2-naphthoic acid	25	2.71		171	Phenoxyacetic acid	25	3.17	
114	5-Aminosalicylic acid (5-Amino-2-hydroxybenzoic acid)	25	2.74	5.84	172	Iodoacetic acid	25	3.18	
115	Triethylsuccinic acid	25	2.74		173	3-Iodo-2-methylbenzoic acid	20	3.18	
116	Salicylic acid (2-Hydroxybenzoic acid)	30	2.75, (3.00)	12.38	174	2-Hydroxy-3-chloroisobutyric acid	25	3.20	
117	2,4-Dichlorobenzoic acid	25	2.76		175	(4-Methoxyphenoxy)acetic acid	25	3.21	
118	1,2,3-Benzenetricarboxylic acid	25	2.80	4.20	176	(4-Methylphenoxy)acetic acid	25	3.22	
119	3,4-Dinitrobenzoic acid	25	2.82	pK <sub>s</sub> = 5.87	177	<i>meso</i> -Tartaric acid	25	3.22	4.82
120	3,5-Dinitrobenzoic acid	25	2.82		178	2-Chlorocrotonic acid	25	3.22	
121	Guanidinoacetic acid	25	2.82		179	2,4-Dihydroxybenzoic acid	30	3.22	
122	2-Bromobenzoic acid	25	2.85		180	(2-Methoxyphenoxy)acetic acid	25	3.23	
123	Malonic acid	25	2.86	5.65	181	(2-Methylphenoxy)acetic acid	25	3.23	
124	Chloroacetic acid	25	2.86		182	Cyclopentane-1,1-dicarboxylic acid	25	3.23	4.08
125	Ethylmethylmalonic acid	25	2.86	6.43	183	3-Bromomandelic acid	25	3.23	
126	2-Iodobenzoic acid	25	2.86		184	3-Chloromandelic acid	25	3.24	
127	2-Chloropropionic acid	18	2.88		185	2,6-Dimethylbenzoic acid	25	3.25	
128	(4-Nitrophenoxy)acetic acid	25	2.89		186	3-Iodomandelic acid	25	3.26	
129	Bromoacetic acid	25	2.90		187	2-Fluorobenzoic acid	25	3.27	
130	2-Chlorobenzoic acid	25	2.92		188	3-Chloro-2-methylbenzoic acid	25	3.27	
131	(4-Cyanophenoxy)acetic acid	25	2.93		189	(4-Chloro-2-methylphenoxy)acetic acid	25	3.28	
132	Isopropylmalonic acid	25	2.94	5.38	190	3-Bromo-2-methylbenzoic acid	20	3.28	
133	(3-Nitrophenoxy)acetic acid	25	2.95		191	<i>cis</i> -3-Chloroacrylic acid	18	3.32	
134	Phthalic acid	25	2.95	5.41	192	<i>cis</i> -Cyclopropane-1,1,2-dicarboxylic acid	24	3.33	6.47
135	2-Chloroisobutyric acid	18	2.97		193	(2,6-Dimethylphenoxy)acetic acid	25	3.36	
136	3,5-Dinitro-4-methylbenzoic acid	25	2.97		194	Anthraquinone-1-carboxylic acid	20	3.37	
137	(2-Cyanophenoxy)acetic acid	25	2.97		195	3-Hydroxy-3-phenylpropionic acid	18	3.40	
138	2-Bromopropionic acid	18	2.97		196	<i>d,l</i> -Mandelic acid	25	3.41	
139	Ethylmalonic acid	25	2.99	5.83	197	Anthraquinone-2-carboxylic acid	20	3.42	
140	<i>n</i> -Propylmalonic acid	25	2.996	5.84	198	<i>N</i> -Formylglycine	19	3.43	
141	<i>d</i> -Tartaric acid	25	3.00	4.34	199	2,4,6-Trimethylbenzoic acid	25	3.44	
142	Fumaric acid	25	3.02	4.38	200	3-Nitrobenzoic acid	25	3.44	
143	(3-Cyanophenoxy)acetic acid	25	3.03		201	Cyclohexane-1,1-diacetic acid	25	3.45	7.08
144	Benzilic acid	18	3.05		202	2-Phenylbenzoic acid (Biphenyl-2-carboxylic acid)	25	3.46	
146	Methylmalonic acid	25	3.05	5.76	203	<i>meso</i> -2,3-Diphenylsuccinic acid	25	3.48	
147	(2-Chlorophenoxy)acetic acid	25	3.05		204	(2,4-Dinitrophenyl)acetic acid	25	3.50	
148	3,3,3-Trifluoropropionic acid	25	3.06		205	Tetramethylsuccinic acid	25	3.50	7.28
149	3-Aminobenzoic acid	25	3.07	4.73	206	<i>d,l</i> -2,3-Diethylsuccinic acid	25	3.51	6.60
150	(3-Chlorophenoxy)acetic acid	25	3.07		207	2-Phenoxybenzoic acid	20	3.53	
151	2-Hydroxy-3-chlorobutyric acid	25	3.08		208	2-Hydroxy-2-phenylpropionic acid	18	3.53	
152	(3-Fluorophenoxy)acetic acid	25	3.09		210	Terephthalic acid	25	3.54	4.46
153	(2-Fluorophenoxy)acetic acid	25	3.09		211	2- <i>tert</i> -Butylbenzoic acid	25	3.54	
154	(4-Chlorophenoxy)acetic acid	25	3.10		212	3-Aminopropionic acid	25	3.55	
155	(3-Bromophenoxy)acetic acid	25	3.10		213	4-Cyanobenzoic acid	25	3.55	
156	$\alpha$ -Iodopropionic acid	18	3.11		214	3-(Methylamino)benzoic acid	25	3.55	
157	(2-Bromophenoxy)acetic acid	25	3.12		215	3-Methoxy-2-methylbenzoic acid	20	3.58	
158	3-Chlorolactic acid	25	3.12		216	<i>d,l</i> -2,3-Diphenylsuccinic acid	25	3.58	
159	(4-Bromophenoxy)acetic acid	25	3.13		217	2-Aminocyclohexanecarboxylic acid	25	3.59	10.21
160	(3-Iodophenoxy)acetic acid	25	3.13		218	3-Cyanobenzoic acid	25	3.60	
161	(4-Fluorophenoxy)acetic acid	25	3.13		219	3-Ethoxy-2-methylbenzoic acid	20	3.62	
					220	Isophthalic acid	25	3.62	4.60
					221	3-Ethyl-3-methylglutaric acid	25	3.62	6.70

TABLE XXVII. ACID DISSOCIATION CONSTANTS OF ORGANIC ACIDS IN AQUEOUS SOLUTION (Listed in order of increasing pK<sub>a</sub>) (Continued)

No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>
222	3,3-Diethylglutaric acid	25	3.62	7.12	279	<i>cis</i> -Tetrahydronaphthalene-2,3-dicarboxylic acid	20	3.98	6.47
223	<i>meso</i> -2,3-Diethylsuccinic acid	25	3.63	6.46	280	4-Chlorobenzoic acid	25	3.98	
224	(2,4-Dichlorophenoxy)acetic acid	20	3.64		281	2,5-Dimethylbenzoic acid	25	3.98	
225	Malonic acid (Malonic acid monoamide)	25	3.64		282	3-Bromopropionic acid	18	3.99	
226	2-Isopropylbenzoic acid	25	3.64		283	2-Hydroxy-2-methylbutyric acid	18	3.99	
227	Decahydronaphthoxyacetic acid	25	3.64		284	3-Cyanopropionic acid	25	3.99	
228	2-Cyclohexyloxypropionic acid	25	3.64		285	3-Chloropropionic acid	25	3.996	
229	<i>trans</i> -3-Chloroacrylic acid	18	3.65		286	<i>trans</i> -Tetrahydronaphthalene-2,3-dicarboxylic acid	20	4.00	5.70
230	9-Anthracenecarboxylic acid	20	3.65		287	(2-Nitrophenyl)acetic acid	25	4.004	
231	Ethoxyacetic acid	18	3.65		288	3-Aminopentanoic acid	25	4.02	10.40
232	<i>trans</i> -Cyclopropane-1,2-dicarboxylic acid	24	3.65	5.13	289	4-Aminobutyric acid	25	4.03	
233	N-Acetylglycine	25	3.67		290	<i>cis</i> -Cyclobutane-1,3-dicarboxylic acid	25	4.03	5.31
234	1-Anthracenecarboxylic acid	20	3.68		291	2-Hydroxyisobutyric acid	18	4.04	
235	2-Benzyl-2-phenylsuccinic acid	20	3.69	6.49	292	(2-Iodophenyl)acetic acid	25	4.04	
236	3,3-Di- <i>n</i> -propylglutaric acid	25	3.69	7.31	293	<i>trans</i> -4-Nitrocinnamic acid	25	4.05	
237	Cyclopentyloxyacetic acid	25	3.70		294	(2-Bromophenyl)acetic acid	25	4.05	
238	3,3-Dimethylglutaric acid	25	3.70	6.29	295	(2-Chlorophenyl)acetic acid	25	4.07	
239	<i>cis</i> -3-Aminocyclohexanecarboxylic acid	15	3.70		296	2-Methoxybenzoic acid	20	4.08	
240	<i>d,l</i> -N-Acetylalanine	25	3.72		297	3-Methoxybenzoic acid	25	4.09	
241	N-Propionylglycine	25	3.72		298	3-Iodopropionic acid	18	4.09	
242	2,3-Dimethylbenzoic acid	25	3.74		299	<i>cis</i> -Cyclohexane-1,3-dicarboxylic acid	16	4.10	5.46
243	Formic acid	25	3.74		300	Ethylsuccinic acid	25	4.00	
244	Phthalamic acid (Phthalic acid monoamide)	25	3.75		301	Iminodipropionic acid	30	4.11	9.61
245	Glutaconic acid	25	3.77	5.08	302	Benzylsuccinic acid	20	4.11	5.65
246	<i>meso</i> -2,3-Dimethylsuccinic acid	25	3.77	5.94	303	<i>trans</i> -3-Nitrocinnamic acid	25	4.12	
247	2-Ethylbenzoic acid	25	3.79		304	4-Fluorobenzoic acid	25	4.14	
248	3-Methylcyclopentyl-1,1-diacetic acid	25	3.79	6.74	305	(3-Chlorophenyl)acetic acid	25	4.14	
249	<i>trans</i> -Cyclobutane-1,2-dicarboxylic acid	20	3.79	5.61	306	4,4,4-Trifluorobutyric acid	25	4.15	
250	Cyclohexyloxyacetic acid	25	3.80		307	<i>trans</i> -2-Nitrocinnamic acid	25	4.15	
251	2-Hydroxybutyric acid	18	3.80		308	3-Isopropoxybenzoic acid	20	4.15	
252	Cyclopentyl-1,1-diacetic acid	25	3.80	6.77	309	2-Naphthoic acid	25	4.16	
253	3-Bromobenzoic acid	25	3.81		310	Succinic acid	25	4.16	5.61
254	3-Chlorobenzoic acid	25	3.82		311	(3-Iodophenyl)acetic acid	25	4.16	
255	<i>trans</i> -Carbonic acid ( <i>trans</i> -1,1-Dimethyl-2,3-cyclopropanedicarboxylic acid)	25	3.82	5.32	312	3-Ethoxybenzoic acid	20	4.17	
256	2,2-Diethylsuccinic acid	25	3.84		313	2,2-Diphenyladipic acid	20	4.17	5.80
257	<i>trans</i> -3-Aminocyclohexanecarboxylic acid	15	3.85		314	(4-Iodophenyl)acetic acid	25	4.18	
258	3-Iodobenzoic acid	25	3.85		315	2-Anthracenecarboxylic acid	20	4.18	
259	(4-Nitrophenyl)acetic acid	25	3.85		316	<i>trans</i> -Cyclohexane-1,4-dicarboxylic acid	16	4.18	
260	<i>cis</i> -3-Methylcyclohexyloxyacetic acid	25	3.85		317	4,4,5,5,6,6,6-Heptafluorohexanoic acid	25	4.18	
261	Lactic acid	25	3.86		318	2,4-Dimethylbenzoic acid	25	4.18	
262	<i>cis</i> -Cinnamic acid	25	3.88		319	<i>trans</i> -Cyclohexane-1,2-dicarboxylic acid	19	4.18	5.93
263	Hydroxyacetic acid	25	3.89		320	(4-Bromophenyl)acetic acid	25	4.19	
264	1,2,3-Cyclohexanetricarboxylic acid	23	3.89	4.85	321	(4-Chlorophenyl)acetic acid	25	4.19	
				pK <sub>3</sub> = 8.83	322	Mesaconic acid	18	4.20	
265	<i>cis</i> -Cyclobutane-1,2-dicarboxylic acid	19	3.90	5.89	323	Benzoic acid	25	4.20	
266	2-Methylcyclohexyloxyacetic acid	25	3.90		324	3-Propoxybenzoic acid	20	4.20	
267	3-Fluorobenzoic acid	25	3.90		325	2-Ethoxybenzoic acid	20	4.21	
268	3-Hydroxybenzoic acid	30	3.90	9.78	326	3,4-Diphenyladipic acid	25	4.22	5.19
269	2-Methylbenzoic acid	25	3.91		327	<i>trans</i> -2-Chlorocinnamic acid	25	4.23	
270	2,2-Diphenylglutaric acid	20	3.91	5.38	328	3-Fluoromandelic acid	25	4.24	
271	3-Phenoxybenzoic acid	20	3.91		329	(1-Naphthyl)acetic acid	25	4.24	
272	2-(Bromomethyl)butyric acid	18	3.92		330	(2-Isopropoxy)benzoic acid	20	4.24	
273	Diphenylacetic acid	25	3.94		331	2-Propoxybenzoic acid	20	4.24	
274	2,2-Dibenzylsuccinic acid	20	3.96	6.66	332	3-Butoxybenzoic acid	20	4.25	
275	Triphenylacetic acid	25	3.96		333	(4-Fluorophenyl)acetic acid	25	4.25	
276	<i>trans</i> -Cyclopentane-1,2-dicarboxylic acid	25	3.96	5.85	334	Acrylic acid	25	4.25	
277	4-Bromobenzoic acid	25	3.97		335	3-Methylglutaric acid	25	4.25	5.41
278	(3-Nitrophenyl)acetic acid	25	3.97		336	(2-Naphthyl)acetic acid	25	4.26	
					337	<i>cis</i> -Cyclopentane-1,3-dicarboxylic acid	25	4.26	5.51
					338	5-Aminopentanoic acid	25	4.27	

TABLE XXVII. ACID DISSOCIATION CONSTANTS OF ORGANIC ACIDS IN AQUEOUS SOLUTION (Listed in order of increasing pKa) (Continued)

No	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>
339	3-Methylbenzoic acid	25	4.27		401	3-(2-Chlorophenyl)propionic acid	25	4.58	
340	2,2-Diphenylpimelic acid	25	4.28	5.39	402	3-(3-Chlorophenyl)propionic acid	25	4.58	
341	3-Ethylglutaric acid	25	4.29	5.33	403	4-Methyl-3-pentenoic acid	25	4.60	
342	Angelica acid	18	4.29		404	cis-3-Hydroxycyclohexanecarboxylic acid	25	4.60	
343	trans-3-Chlorocinnamic acid	25	4.29		405	2-Hydroxycinnamic acid	25	4.61	
344	3,5-Dimethylbenzoic acid	25	4.30		406	4-Hydroxybenzoic acid	27.8	4.61	9.31
345	3-Isopropylglutaric acid	25	4.30	5.51	407	Levulinic acid	18	4.64	
346	3-n-Propylglutaric acid	25	4.31	5.31	408	2-Methyl-3-hydroxybutyric acid	18	4.65	
347	Phenylacetic acid	25	4.31		409	3-(3-Methoxyphenyl)propionic acid	25	4.65	
348	trans-Cyclohexane-1,3-dicarboxylic acid	19	4.31	5.73	410	4-Acetylbutyric acid	18	4.66	
349	2,2-Diphenylsuccinic acid	20	4.31	5.39	411	2-Methylacrylic acid	18	4.66	
350	trans-Cyclopentane-1,3-dicarboxylic acid	25	4.32	5.42	412	3-Phenylpropionic acid	25	4.66	
351	2,2-Diphenylazelaic acid	20	4.33	5.38	413	3-(2-Methylphenyl)propionic acid	25	4.66	
352	(3,4-Dimethoxyphenyl)acetic acid	25	4.33		414	4-Pentenoic acid	25	4.67	
353	3,4,5-Trihydroxybenzoic acid	30	4.33		415	4-Ureidobutyric acid	25	4.68	
354	cis-Cyclohexane-1,2-dicarboxylic acid	20	4.34	6.77	416	3-(3-Methylphenyl)propionic acid	25	4.68	
355	4-Isopropylbenzoic acid	25	4.35		417	3-(4-Methylphenyl)propionic acid	25	4.68	
356	Vinylacetic acid	25	4.35		418	(4-Isopropoxy)benzoic acid	20	4.68	
357	Glutaric acid	25	4.35	5.42	419	trans-2-Hydroxycyclohexanecarboxylic acid	25	4.68	
358	4-Ethylbenzoic acid	25	4.35		420	trans-4-Hydroxycyclohexanecarboxylic acid	25	4.68	
359	(4-Methoxyphenyl)acetic acid	25	4.36		421	3-(4-Methoxyphenyl)propionic acid	25	4.69	
360	4-Methylbenzoic acid	25	4.37		422	2-Pentenoic acid	25	4.69	
361	(4-Methylphenyl)acetic acid	25	4.37		423	trans-Crotonic acid	25	4.69	
362	(4-Ethylphenyl)acetic acid	25	4.37		424	4-Hydroxypentanoic acid	18	4.69	
363	4-Methoxycinnamic acid	25	4.38		425	2-Hexenoic acid	25	4.70	
364	trans-Cyclohexane-1,2-diacetic acid	20	4.38	5.42	426	4-Hexenoic acid	25	4.72	
365	(4-Isopropylphenyl)acetic acid	25	4.39		427	5-Hexenoic acid	25	4.72	
366	trans-4-Aminocyclohexanecarboxylic acid	25	4.39	10.55	428	2-Ethylpentanoic acid	18	4.72	
367	3-Hydroxycinnamic acid	25	4.40		429	2-Ethylbutyric acid	25	4.75	
368	4-tert-Butylbenzoic acid	25	4.40		430	4-Phenylbutyric acid	25	4.76	
369	cis-Crotonic acid	18	4.41		431	Acetic acid	25	4.76	
370	3,4-Dimethylbenzoic acid	25	4.41		432	Isovaleric acid	25	4.78	
371	trans-2-Bromocinnamic acid	25	4.41		433	4-Propoxybenzoic acid	20	4.78	
372	cis-Cyclohexane-1,2-diacetic acid	20	4.42	5.45	434	4,4-Dimethylpentanoic acid	18	4.79	
373	cis-Cyclopentane-1,2-diacetic acid	20	4.42	5.42	435	Cyclobutanecarboxylic acid	25	4.79	
374	(4-tert-Butylphenyl)acetic acid	25	4.42		436	d,l-2-Methylpentanoic acid	18	4.79	
375	trans-Cyclopentane-1,2-diacetic acid	20	4.43	5.43	437	5-Methyl-4-hexenoic acid	25	4.80	
376	trans-4-Chlorocinnamic acid	25	4.43		438	4-Methyl-2-pentenoic acid	25	4.80	
377	Adipic acid	25	4.43	5.42	439	3-(2-Methoxyphenyl)propionic acid	25	4.80	
378	4-Cyanobutyric acid	25	4.44		440	2-Methylbutyric acid	18	4.81	
379	trans-Cinnamic acid	25	4.44		441	n-Butyric acid (n-Butanoic acid)	25	4.82	
380	trans-3-Methylcinnamic acid	25	4.44		442	trans-3-Hydroxycyclohexanecarboxylic acid	25	4.82	
381	3-(Acetylamino)propionic acid	25	4.45		443	Nicotinic acid	25	4.82	11.98
382	2-Ureidoisobutyric acid	25	4.46		444	Cyclopropanecarboxylic acid	25	4.83	
383	4-Methoxybenzoic acid	25	4.47		445	cis-4-Aminocyclohexanecarboxylic acid	25	4.83	10.62
384	3-(4-Nitrophenyl)propionic acid	25	4.47		446	d,l-3-Methylpentanoic acid	18	4.84	
385	Pimelic acid	25	4.48	5.42	447	Isonicotinic acid	20	4.84	12.23
386	3-(1-Naphthyl)propionic acid	20	4.48		448	cis-4-Hydroxycyclohexanecarboxylic acid	25	4.84	
387	3-Methylcyclohexyl-1,1-diacetic acid	25	4.49	6.08	449	Isocaproic acid	18	4.84	
388	4-Methylcyclohexyl-1,1-diacetic acid	25	4.49	6.10	450	n-Pentanoic acid (n-Valeric acid)	25	4.84	
389	5,5,5-Trifluoropentanoic acid	25	4.49		451	Isobutyric acid	25	4.86	
390	3-Ureidopropionic acid	25	4.49		452	Propionic acid (Propanoic acid)	25	4.87	
391	3-(2-Nitrophenyl)propionic acid	25	4.50		453	4-Hydroxyisocaproic acid	18	4.87	
392	trans-2-Methylcinnamic acid	25	4.50		454	n-Hexanoic acid (n-Caproic acid)	25	4.88	
393	2-Methoxycinnamic acid	25	4.50		455	n-Heptanoic acid	25	4.89	
394	3-Hexenoic acid	25	4.52		456	n-Octanoic acid (n-Caprylic acid)	25	4.89	
395	Suberic acid	25	4.52	5.40	457	Cyclohexylpropionic acid	25	4.91	
396	Azelaic acid	25	4.53	5.40	458	d,l-2,3-Dimethylsuccinic acid	25	4.94	6.20
398	Succinamic acid (Succinic acid monoamide)	25	4.54		459	n-Nonanoic acid (Pelargonic acid)	25	4.94	
399	trans-4-Methylcinnamic acid	20	4.56		460	Cyclohexylbutyric acid	25	4.95	
400	O-Acetylsalicylic acid (Aspirin)	17	4.57						

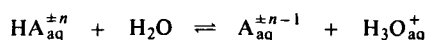


**TABLE XXVII. ACID DISSOCIATION CONSTANTS OF  
ORGANIC ACIDS IN AQUEOUS SOLUTION  
(Listed in order of increasing pKa) (Continued)**

No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>
461	<b>Tiglic acid</b>	18	4.96		468	<i>cis</i> -3-Methyl-2-pentenoic acid	25	5.15	
462	<b>3-(2-Naphthoyl)propionic acid</b>	20	4.96		469	<b>Itaconic acid</b>	18	5.54	
463	<b>Cyclopentanecarboxylic acid</b>	25	4.99		470	<b>Citraconic acid</b>	18	6.17	
464	<b>2,2-Dimethylbutyric acid</b>	18	5.03		471	<b>Ethylenediamine-N,N,N',N'-tetraacetic acid</b>	25	6.27	10.95
465	<b>Trimethylacetic acid</b>	25	5.05		472	<b>Ethylenediamine-N,N'-diacetic acid</b>	30	6.42	9.46
466	<b>3,3-Dimethylacrylic acid (3-Methylcrotonic acid)</b>	25	5.12		473	<b>Ethylenediamine-N,N'-dipropionic acid</b>	30	6.87	9.60
467	<b>trans</b> -3-Methyl-2-pentenoic acid	25	5.13						

## EXPLANATIONS AND REFERENCES TO TABLES XXVII, XXVIII AND XXIX

The dissociation of an organic carboxylic acid, phenol or the conjugate acid of an amine in aqueous solution is expressed by the equation



and the corresponding equilibrium constant  $K_e$  is given by

$$K_e = \frac{(a_{\text{A}_{\text{aq}}^{\pm n-1}})(a_{\text{H}_3\text{O}^+})}{(a_{\text{HA}_{\text{aq}}^{\pm n}})(a_{\text{H}_2\text{O}})}$$

where the  $a$ 's are the activities of the species. At low electrolyte concentrations  $a_{\text{H}_2\text{O}}$  is virtually constant, and a second constant,  $K_a$ , the thermodynamic dissociation constant, is defined as

$$K_a = K_e(a_{\text{H}_2\text{O}}) = \frac{(a_{\text{A}_{\text{aq}}^{\pm n-1}})(a_{\text{H}_3\text{O}^+})}{(a_{\text{HA}_{\text{aq}}^{\pm n}})} = \frac{(c_{\text{A}_{\text{aq}}^{\pm n-1}})(c_{\text{H}_3\text{O}^+})}{(c_{\text{HA}_{\text{aq}}^{\pm n}})} \cdot \frac{f_{\pm}^2}{f_{\text{HA}_{\text{aq}}^{\pm n}}}$$

where the  $c$ 's are the concentrations and the  $f$ 's are the activity coefficients of the species

The dissociation constants in the Tables are given in the more convenient  $pK_a$  notation, where

$$pK_a = -\log K_a$$

For Table XXVII,  $\text{HA}^{\pm n} = \text{RCOOH}$ , and  $\text{A}^{\pm n-1} = \text{RCOO}^-$

For Table XXVIII,  $\text{HA}^{\pm n} = \text{ArOH}$ , and  $\text{A}^{\pm n-1} = \text{ArO}^-$

For Table XXIX,  $\text{HA}^{\pm n} = \text{RR}'\text{R}''\text{NH}^+$  and  $\text{A}^{\pm n-1} = \text{RR}'\text{R}''\text{N}$  ( $\text{R}$ ,  $\text{R}'$  and  $\text{R}''$  may be alkyl or aryl groups or a hydrogen atom)

For monobasic acids  $pK_a = pK_1$

For dicarboxylic acids both  $pK_1$  and  $pK_2$  are given,  $pK_1$  is defined above, and  $pK_2$  is the analogous dissociation constant of the monoanion,  $\text{A}^{\pm n-1}$ , obtained on the first dissociation. For other dibasic acids such as the conjugate acids of amino acids, or diamines,  $pK_1$  is as defined above, and  $pK_2$  is the dissociation constant for the species obtained after the first protonation.

For a comprehensive compilation of the dissociation constants of organic acids (including phenols) in aqueous solution, as well as summary of the methods for  $pK$  determinations, see G Kortum, W Vogel and K Andrussov, in *Pure and Applied Chemistry*, Vol 1, Butterworths, London, 1961, pp 190-536

For a comprehensive compilation of the dissociation constants of organic bases (especially amines) in aqueous solution see D D Perrin, *Dissociation Constants of Organic Bases in Aqueous Solution*, Butterworths, London, 1965

For general references including methods of determination of  $pK$ , and data for both acids and bases see J F King, in *Elucidation of Structures by Physical and Chemical Methods*, Vol 1 (Ed K W Bentley) (*Technique of Organic Chemistry*, Vol 9), Interscience, New York, 1963, Chapter 6, pp 318-401, H C Brown, D H McDaniel and O Hafiger in *Determination of Organic Structures by Physical Methods*, Vol 1 (Ed E A Braude and F C Nachod), Academic Press, New York, 1955, Chapter 14, p 567

\*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives

**TABLE XXVIII. ACID DISSOCIATION CONSTANTS OF PHENOLS  
IN AQUEOUS SOLUTION  
(Listed in order of increasing pK<sub>a</sub>)**

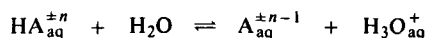
No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>
1	Picric acid (2,4,6-Trinitrophenol)	25	0.29 (0.71)		51	2-Hydroxy-3-methoxybenzylamine	25	8.70	10.52
2	4-Hydroxypyrimidine	20	1.85	8.59	52	3-Hydroxypyridine	20	8.72	
3	2-Hydroxypyrimidine	20	2.24	9.17	53	2-Fluorophenol	25	8.82	
4	4-Chloro-2,6-dinitrophenol	25	2.97		54	Isovanillin (5-Formyl-2-methoxyphenol 3-Hydroxy-4-methoxybenzaldehyde)	25	8.889	
5	2,6-Dinitrophenol	25	3.71		55	3-Hydroxy-2-methoxybenzylamine	25	8.89	10.52
6	2,4-Dinitrophenol	25	4.09		56	4-Hydroxy-3-methoxybenzylamine	25	8.94	10.42
7	2,6-Dinitrohydroquinone	21	4.42	9.14	57	3-Nitro-2,4,6-trimethylphenol	25	8.98	
8	8-Hydroxyquinoline	20	5.017	9.813	58	Sodium 4-hydroxybenzenesulfonate	25	9.01	
9	2,5-Dinitrophenol	25	5.04		59	Pyrogallol (1,2,3-Trihydroxybenzene)	25	9.01	11.64
10	3,4-Dinitrophenol	25	5.42		60	2-Methylhydroquinone (Toluhydroquinone)	25	9.05	11.62
11	8-Hydroxyquinaldine	25	5.55	10.31	61	3-Chlorophenol	25	9.08 (9.02)	
12	4-Methyl-8-hydroxyquinoline	25	5.58	10.00	62	3-Bromophenol	25	9.11	
13	3,4-Dimethyl-8-hydroxyquinoline	25	5.80	10.05	63	3-Iodophenol	25	9.17	
14	5-Formyl-2-nitrophenol (3-Hydroxy-4-nitrobenzaldehyde)	25	6.00		64	3-Acetylphenol	25	9.19	
15	5-Chloro-2-nitrophenol	25	6.05		65	4-Iodophenol	25	9.20	
16	5-Carboethoxy-2-nitrophenol (Ethyl 3-hydroxy-4-nitrobenzoate)	25	6.11		66	Sodium 3-hydroxybenzenesulfonate	25	9.29	
17	5-Carbomethoxy-2-nitrophenol (Methyl 3-hydroxy-4-nitrobenzoate)	25	6.15		67	1-Naphthol	20.5	9.30 (9.85)	
18	2,4-Dimethyl-8-hydroxyquinoline	25	6.20	10.60	68	3-(Methylsulfonyl)phenol	25	9.33	
19	3-Nitrocatechol	25	6.68		69	4-Bromophenol	25	9.34	
20	2-Nitro-5-phenylphenol (3-Hydroxy-4-nitrobiphenyl)	25	6.74		70	3-Fluorophenol	25	9.36 (9.28)	
21	2-Formylphenol (Salicylaldehyde)	25	6.79		71	1,4-Naphthohydroquinone (1,4-Dihydroxynaphthalene)	26.5	9.37	10.93
22	5-Methoxy-2-nitrophenol	25	7.09		72	4-Chlorophenol	25	9.38 (9.42)	
23	4-Nitrophenol	25	7.16		73	Sodium 4-hydroxybenzoate	20	9.39	
24	2-Nitrophenol	25	7.21		74	Resorcinol (1,3-Dihydroxybenzene)	30	9.44	11.32
25	2,6-Dimethyl-4-nitrophenol	25	7.22		75	Catechol (1,2-Dihydroxybenzene)	30	9.48	12.08
26	5-Methyl-2-nitrophenol	25	7.25		76	4-Phenylphenol (4-Hydroxybiphenyl)	22.5	9.51	
27	2,6-Dichlorohydroquinone	25	7.30	9.99	77	3-(Methylthio)phenol	25	9.53	
28	Vanillin (4-Formyl-2-methoxyphenol 4-Hydroxy-3-methoxybenzaldehyde)	25	7.396		78	4-(Methylthio)phenol	25	9.53	
29	2-Nitrohydroquinone	21	7.63	10.06	79	2,4,6-Trimethylolphenol	25	9.56	
30	4-Formylphenol (4-Hydroxybenzaldehyde)	25	7.66		80	2-Naphthol	19.5	9.57, (9.93)	
31	4-(Methylsulfonyl)phenol	25	7.83		81	3-Phenylphenol (3-Hydroxybiphenyl)	22.5	9.64	
33	<i>o</i> -Vanillin (2-Formyl-6-methoxyphenol, 2-Hydroxy-3-methoxybenzaldehyde)	25	7.91		82	3-Methoxyphenol	25	9.65	
34	4-Cyanophenol (4-Hydroxybenzonitrile)	25	7.95		83	2,6-Dimethylolphenol	25	9.66	
35	3-Formylphenol (3-Hydroxybenzaldehyde)	25	8.00		84	2-Aminophenol (2-Hydroxyaniline)	28	9.71	
36	4-Acetylphenol	25	8.05		85	2,4-Dimethylolphenol	25	9.77	
37	3,5-Dimethyl-4-(methylsulfonyl)phenol	25	8.13		86	4-Methylolphenol	25	9.82	
38	4-Cyano-3,5-dimethylphenol (2,6-Dimethyl-4-hydroxybenzonitrile)	25	8.21		87	3-Methylolphenol	25	9.83	
39	3,5-Dimethyl-4-nitrophenol	25	8.25		88	3-Aminophenol (3-Hydroxyaniline)	21.5	9.87	9.92
40	4-Cyano-2,6-dimethylphenol (3,5-Dimethyl-4-hydroxybenzonitrile)	25	8.27		89	Sodium 4-hydroxybenzenephosphonate	25	9.90	
41	2-Carboxamidophenol (Salicylamide)	20	8.37		90	3-Ethylphenol	28	9.90	
42	3-Nitrophenol	25	8.38		91	2,6-Dimethylol-4-methylphenol	25	9.92	
43	4-Carbobenzyloxyphenol (Benzyl 4-hydroxybenzoate)	25	8.41		92	2-Methylolphenol	25	9.92	
44	2-Bromophenol	25	8.42		93	4-Fluorophenol	25	9.92	
45	Phloroglucinol (1,3,5-Trihydroxybenzene)	25	8.45 (7.0)	8.88	94	Sodium 3-hydroxybenzoate	20	9.94	
46	2-Iodophenol	25	8.46		95	2-Methoxyphenol	25	9.98	
47	4-Carbobutoxyphenol ( <i>n</i> -Butyl 4-hydroxybenzoate)	25	8.47		96	Phenol	25	9.99, (9.95)	
48	4-Carbomethoxyphenol (Methyl 4-hydroxybenzoate)	25	8.47		97	Eugenol (4-Allyl-2-methoxyphenol)	25	10.00	
49	2-Chlorophenol	25	8.48		98	2-Phenylphenol (2-Hydroxybiphenyl)	22.5	10.01	
50	4-Carboethoxyphenol (Ethyl 4-hydroxybenzoate)	25	8.50		99	4-Ethylphenol	28	10.01	
					100	3-Methylphenol ( <i>m</i> -Cresol)	25	10.09	
					101	3-Ethyl-5-methylphenol	28	10.10	
					102	3,5-Dimethylphenol	25	10.15	
					103	4-Methyl-2-methylolphenol	25	10.15	
					104	4-Methoxyphenol	25	10.20	
					105	Sodium 3-hydroxybenzenephosphonate	25	10.2	

**TABLE XXVIII. ACID DISSOCIATION CONSTANTS OF PHENOLS  
IN AQUEOUS SOLUTION  
(Listed in order of increasing pK<sub>a</sub>)**

No.	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>	No.	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>
106	2-Ethylphenol	28	10.2		115	2,6-Dimethylphenol	25	10.59	
107	2,5-Dimethylphenol	24	10.22		116	2,4,6-Trimethylphenol	25	10.88, (10.99)	
108	4-Methylphenol ( <i>p</i> -Cresol)	25	10.26		117	Hydroquinone (1,4-Dihydroxybenzene)	25	10.85, (9.96)	11.39
109	2-Methylphenol ( <i>o</i> -Cresol)	25	10.28		118	4-Hydroxypyridine	20	11.09	
110	4-Indanol	25	10.32		119	Tetramethylhydroquinone (Durohydroquinone)	25	11.51	
111	3,4-Dimethylphenol	25	10.32		120	2-Hydroxypyridine	20	11.62	
112	2,4,5-Trimethylphenol	25	10.45						
113	2,4-Dimethylphenol	25	10.45						
114	2,3-Dimethylphenol	25	10.50						

## EXPLANATIONS AND REFERENCES TO TABLES XXVII, XXVIII AND XXIX

The dissociation of an organic carboxylic acid, phenol or the conjugate acid of an amine in aqueous solution is expressed by the equation



and the corresponding equilibrium constant  $K_e$  is given by

$$K_e = \frac{(a_{\text{A}_{\text{aq}}^{\pm n-1}})(a_{\text{H}_3\text{O}^+})}{(a_{\text{HA}_{\text{aq}}^{\pm n}})(a_{\text{H}_2\text{O}})}$$

where the  $a$ 's are the activities of the species. At low electrolyte concentrations  $a_{\text{H}_2\text{O}}$  is virtually constant, and a second constant,  $K_a$ , the thermodynamic dissociation constant, is defined as

$$K_a = K_e(a_{\text{H}_2\text{O}}) = \frac{(a_{\text{A}_{\text{aq}}^{\pm n-1}})(a_{\text{H}_3\text{O}^+})}{(a_{\text{HA}_{\text{aq}}^{\pm n}})} = \frac{(c_{\text{A}_{\text{aq}}^{\pm n-1}})(c_{\text{H}_3\text{O}^+})}{(c_{\text{HA}_{\text{aq}}^{\pm n}})} \cdot \frac{f_{\pm}^2}{f_{\text{HA}_{\text{aq}}^{\pm n}}}$$

where the  $c$ 's are the concentrations and the  $f$ 's are the activity coefficients of the species

The dissociation constants in the Tables are given in the more convenient  $pK_a$  notation, where

$$pK_a = -\log K_a$$

For Table XXVII,  $\text{HA}^{\pm n} = \text{RCOOH}$ , and  $\text{A}^{\pm n-1} = \text{RCOO}^-$

For Table XXVIII,  $\text{HA}^{\pm n} = \text{ArOH}$ , and  $\text{A}^{\pm n-1} = \text{ArO}^-$

For Table XXIX,  $\text{HA}^{\pm n} = \text{RR}'\text{R}''\text{NH}^+$  and  $\text{A}^{\pm n-1} = \text{RR}'\text{R}''\text{N}$  ( $\text{R}$ ,  $\text{R}'$  and  $\text{R}''$  may be alkyl or aryl groups or a hydrogen atom)

For monobasic acids  $pK_a = pK_1$

For dicarboxylic acids both  $pK_1$  and  $pK_2$  are given,  $pK_1$  is defined above, and  $pK_2$  is the analogous dissociation constant of the monoanion,  $\text{A}^{\pm n-1}$ , obtained on the first dissociation. For other dibasic acids such as the conjugate acids of amino acids, or diamines,  $pK_1$  is as defined above, and  $pK_2$  is the dissociation constant for the species obtained after the first protonation.

For a comprehensive compilation of the dissociation constants of organic acids (including phenols) in aqueous solution, as well as summary of the methods for  $pK$  determinations, see G Kortum, W Vogel and K Andrussov, in *Pure and Applied Chemistry*, Vol 1, Butterworths, London, 1961, pp 190-536

For a comprehensive compilation of the dissociation constants of organic bases (especially amines) in aqueous solution see D D Perrin, *Dissociation Constants of Organic Bases in Aqueous Solution*, Butterworths, London, 1965

For general references including methods of determination of  $pK$ , and data for both acids and bases see J F King, in *Elucidation of Structures by Physical and Chemical Methods*, Vol 1 (Ed K W Bentley) (*Technique of Organic Chemistry*, Vol 9), Interscience, New York, 1963, Chapter 6, pp 318-401, H C Brown, D H McDaniel and O Hafiger in *Determination of Organic Structures by Physical Methods*, Vol 1 (Ed E A Braude and F C Nachod), Academic Press, New York, 1955, Chapter 14, p 567

\*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives

TABLE XXIX. DISSOCIATION CONSTANTS OF ORGANIC BASES IN AQUEOUS SOLUTION

(Listed in order of increasing pK<sub>a</sub>)

(The data relates to the acid dissociation constant (K<sub>a</sub>) of the conjugate acid (BH<sup>+</sup>) of the listed base (B))

No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>
1	2,4,6-Trinitroaniline	25	-9.41		59	2-Amino-6-nitronaphthalene	25	2.62	
2	2,4-Dinitroaniline	25	-4.53		60	N,N-Dimethyl-3-nitroaniline	25	2.63	
3	2,6-Dinitro-4-methylaniline	25	-3.96		61	2-Chloroaniline	25	2.65	
4	2,4-Dichloro-6-nitroaniline	25	-3.61		62	2-Amino-4-cyanonaphthalene	25	2.66	
5	2,6-Dichloro-4-nitroaniline	20	-2.55		63	1-Amino-3-bromonaphthalene	25	2.67	
6	N-Cyanodiethylamine	25	-2.0		64	3-Bromoquinoline	25	2.69	
7	1-Amino-2-nitronaphthalene	25	-1.74		65	1-Amino-3-chloronaphthalene	25	2.69	
8	4-Chloro-2-nitroaniline	25	-1.02		66	5-Nitroquinoline	20	2.69	
9	Dicyanomethyl ethyl amine	25	-0.6		67	6-Nitroquinoline	20	2.72	
10	2-Fluoropyridine	25	-0.44		68	1-Amino-5-nitronaphthalene	25	2.73	
11	Pyrrrole	25	-0.27		69	2-Amino-8-nitronaphthalene	25	2.73	
			(-3.8)		70	3-Cyanoaniline	25	2.748	
12	2-Nitroaniline	25	-0.26		71	1-Amino-8-nitronaphthalene	23	2.79	
13	Bis (cyanomethyl) amine	25	0.2		72	1-Amino-3-iodonaphthalene	25	2.82	
14	2-Chloropyridine	25	0.49,		73	3-Bromopyridine	25	2.84	
			(0.72)		74	3-Chloropyridine	25	2.84	
15	1-Amino-4-nitronaphthalene	20	0.54		75	1-Amino-6-nitronaphthalene	25	2.89	
16	Quinoxaline	20	0.56		76	4-Methyl-3-nitroaniline	25	2.96	
17	N,N-Dimethyl-4-nitroaniline	25	0.607		77	3-Cyano-N,N-dimethylaniline	25	2.969	
18	Pyrazine	27	0.65	-5.78	78	3-Fluoropyridine	25	2.97	
19	Diphenylamine	25	0.79		79	2-Amino-5-nitronaphthalene	25	3.01	
20	3-Nitropyridine	25	0.81		80	2-Methoxypyridine	25	3.06	
21	2-Bromopyridine	25	0.90		81	2-Amino-7-nitronaphthalene	25	3.10	
22	2-Cyanoaniline	25	0.95		82	1,3-Dimethylpyrazole	25	3.11	
23	2,6-Dimethyl-4-nitroaniline	22	0.98		83	2-Methoxyquinoline	20	3.16	
24	4-Nitroaniline	25	1.00		84	3-Acetylpyridine	25	3.18	
25	N-Chlorodiethylamine	25	1.02		85	4-Hydroxypyridine	20	3.20	11 12
26	2-Methyl-4-nitroaniline	24.5	1.04		86	2-Fluoroaniline	25	3.20	
27	2-Bromoquinoline	25	1.05		87	1-Amino-4-bromonaphthalene	25	3.21	
28	Tris (2-cyanoethyl) amine	25	1.1		88	3-Iodopyridine	25	3.25	
29	Pyrimidine	20	1.23		89	1-Amino-3-methoxynaphthalene	25	3.26	
			(1.31)		90	1-Amino-3-hydroxynaphthalene	25	3.30	
30	2-Amino-3-nitronaphthalene	25	1.48		91	1-Amino-5-chloronaphthalene	25	3.34	
31	3-Methyl-4-nitroaniline	25	1.50		92	2-Amino-4-chloronaphthalene	25	3.38	
32	2,5-Dichloroaniline	22	1.57		93	4-Amino fluorene	25	3.39	
33	4-Cyanoaniline	25	1.74		94	2-Amino-4-bromonaphthalene	25	3.40	
34	4-Cyano-N,N-dimethyl aniline	25	1.78		95	2-Amino-4-iodonaphthalene	25	3.41	
35	2-Iodopyridine	25	1.82		96	1-Amino-7-chloronaphthalene	25	3.48	
36	2,3-Dimethyl-4-nitroaniline	25	1.96		97	1-Amino-6-chloronaphthalene	25	3.48	
37	2,4-Dichloroaniline	25	2.00		98	Quinazoline	20	3.49	
38	1-Amino-3-nitronaphthalene	25	2.07		99	3-Chloroaniline	25	3.52	
39	3-Methoxy-5-nitroaniline	25	2.11		100	4-Bromo-2,6-dimethylaniline	25	3.54	
40	4-Aminobenzophenone (4-Benzoylaniline)	25	2.17		101	3-Methylpyrazole	25	3.56	
41	4-Aminoacetophenone (4-Acetylaniline)	25	2.19		102	3-Aminoacetophenone (3-Acetylaniline)	25	3.56	
			(2.75)		103	3-Fluoroaniline	25	3.57	
42	2-Aminoacetophenone (2-Acetylaniline)	25	2.22		104	4-Bromo-2-methylaniline	25	3.58	
43	Pyridazine	20	2.24		105	3-Bromoaniline	25	3.58	
44	1-Amino-3-cyanonaphthalene	25	2.26		106	2-(Methylthio)pyridine	20	3.59	
45	Cinnoline	20	2.27		107	3-Iodoaniline	25	3.61	
46	1,2,4-Triazole	25	2.30		108	5-Bromoquinoline	25	3.62	
47	2,4-Dibromoaniline	15	2.3		109	1-(Methylamino)naphthalene	27	3.67	
48	2,6-Dibromoaniline	25	2.34		110	2-Amino-7-chloronaphthalene	23	3.71	
49	7-Nitroquinoline	20	2.40		111	4-Bromopyridine	20	3.78	
50	2-Amino-4-nitronaphthalene	25	2.43		112	4-Iodoaniline	25	3.78	
51	Thiazole	20	2.44		113	2-Aminobiphenyl	22	3.82	
52	3-Nitroaniline	25	2.466		114	3,5-Dimethoxyaniline	25	3.82	
53	Pyrazole	25	2.48		115	4-Chloropyridine	20	3.84	
54	2-Bromoaniline	25	2.53		116	4-Bromoaniline	25	3.86	
55	1-Amino-7-nitronaphthalene	25	2.55		117	1-Amino fluorene	25	3.87	
56	8-Nitroquinoline	20	2.55		118	1-Amino-6-methoxynaphthalene	25	3.90	
57	3,5-Dimethyl-4-nitroaniline	25	2.59		119	1-Aminonaphthalene	25	3.92	
58	2-Iodoaniline	25	2.60		120	2,6-Dimethylaniline	25	3.95	

TABLE XXIX. DISSOCIATION CONSTANTS OF ORGANIC BASES IN AQUEOUS SOLUTION

(Listed in order of increasing pKa) (Continued)

(The data relates to the acid dissociation constant (Ka) of the conjugate acid (BH<sup>+</sup>) of the listed base (B))

No	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>
121	8-Aminoquinoline	20	3.95		183	8-Methylquinoline	25	4.91	
122	1-Amino-5-hydroxynaphthalene	25	3.96		184	3,5-Dimethylaniline	25	4.91	
123	1-Amino-3-methylnaphthalene	25	3.96		185	3-Aminoquinoline	20	4.91	
124	1-Amino-6-hydroxynaphthalene	25	3.97		186	3-Methoxypyridine	25	4.91	
125	4-Chloroaniline	25	4.00		187	4- <i>tert</i> -Butylaniline	25	4.95	
126	3-(Methylthio)aniline	25	4.00		188	3,5-Di- <i>tert</i> -butylaniline	25	4.97	
127	4-Iodopyridine	20	4.02		189	2-Vinylpyridine	25	4.98	
128	2-Amino-4-methoxynaphthalene	25	4.05		190	1,3-Diaminobenzene ( <i>m</i> -Phenylenediamine)	25	4.98	2.41
129	2-Amino-5-hydroxynaphthalene	25	4.07		191	<i>N</i> ,3-Dimethylaniline	21	5.00	
130	1-Amino-7-methoxynaphthalene	25	4.07		192	2- <i>tert</i> -Butylaniline	25	5.03	
131	3-Bromo-4-methoxyaniline	23	4.08		193	6-Methoxyquinoline	20	5.03	
132	1-Aminoanthracene	25	4.1		194	<i>N</i> , <i>N</i> -Dimethylaniline	25	5.068	
133	2-Aminonaphthalene	25	4.16		195	4-Methylaniline	25	5.08	
134	<i>N</i> -Allylaniline	25	4.17		196	3-Hydroxypyridine	25	5.10	8.60
135	3-Ethoxyaniline	25	4.17		197	<i>N</i> -Ethylaniline	24	5.12	
136	1-(Ethylamino)naphthalene	25	4.18		198	<i>N</i> - <i>n</i> -Butylaniline	25	5.12	
137	2-Amino-7-methoxynaphthalene	25	4.19		199	3,5,6-Trimethylaniline	20.5	5.12	
138	1-Amino-7-hydroxynaphthalene	25	4.20		200	2-Benzylpyridine	25	5.13	
139	3-Methoxyaniline	25	4.20		201	6-Methylquinoline	25	5.15	
140	4-Aminobiphenyl	29	4.22		202	2-Amino-5,6,7,8-tetrahydronaphthalene	17	5.17	
141	4-Bromo- <i>N</i> , <i>N</i> -dimethylaniline	25	4.232		203	3,4-Dimethylaniline	25	5.17	
142	3-Aminobiphenyl	17	4.25		204	4-Ethoxyaniline	28	5.20	
143	2-Amino-7-hydroxynaphthalene	25	4.25		205	4-Methylquinoline	25	5.20	(5.59)
144	2,3,5,6-Tetramethylaniline	25	4.30		206	Pyridine	25	5.25	
145	2-Bromo- <i>N</i> , <i>N</i> -dimethylaniline	25	4.31		207	Bis(2-cyanoethyl)amine	25	5.26	
146	4-(Methylthio)aniline	25	4.35		208	7-Methylquinoline	25	5.29	
147	2- <i>n</i> -Propylaniline	25	4.36		209	<i>N</i> -Cyclopentylaniline	25	5.30	
148	Tris(2-chloroethyl)amine	25	4.37		210	5-Aminoindane	16	5.31	
149	2-Ethylaniline	25	4.37		211	4-Methoxyaniline	25	5.31	
150	2,4,6-Trimethylaniline	25	4.37		212	Aminoacetoneitrile	25	5.34	
151	3,5-Dimethylpyrazole	25	4.38		213	<i>N</i> , <i>N</i> ,3-Trimethylaniline	25	5.344	
152	3-(Methylthio)pyridine	20	4.42		214	<i>N</i> ,4-Dimethylaniline	23	5.36	
153	2-Isopropylaniline	25	4.42		215	Isoquinoline	20	5.42	
154	<i>N</i> -Isobutylaniline	25	4.43		216	<i>N</i> - <i>n</i> -Hexylaniline	19	5.42	
155	2-Ethoxyaniline	28	4.43		217	5-Aminoquinoline	20	5.42	
156	2-Methylaniline	25	4.44		218	2,2,2-Trichloroethylamine	20	5.47	
157	1-Amino-5,6,7,8-tetrahydronaphthalene	16	4.47		219	Benzimidazole	25	5.53	
158	Phenanthridine	20	4.48		220	1-Methylbenzimidazole	25	5.54	
159	2-Methoxyaniline	25	4.52		221	3-Ethylpyridine	25	5.56	
160	2,5-Dimethylaniline	25	4.53		222	1-Ethylbenzimidazole	25	5.59	
161	1-(Cyanomethyl)pyridine	25	4.55		223	6-Aminoquinoline	20	5.59	
162	(Cyanomethyl) diethyl amine	25	4.55		224	<i>N</i> -Cyclohexylaniline	25	5.60	
163	Bis(2-Cyanoethyl) ethyl amine	25	4.55		225	4-Vinylpyridine	25	5.62	
164	2-(Dimethylamino)naphthalene	25	4.566		226	<i>N</i> , <i>N</i> ,4-Trimethylaniline	25	5.627	
165	Aniline	25	4.603		227	3-Methylpyridine	25	5.63	
166	5-Methylquinoline	25	4.62		228	4-Methylbenzimidazole	25	5.65	
167	<i>N</i> ,2-Dimethylaniline	23	4.62		229	<i>N</i> , <i>N</i> -Di- <i>n</i> -propylaniline	23	5.68	
168	2-Aminofluorene	25	4.64		230	2-Methylquinoline	25	5.69	
169	2-Amino-6-methoxynaphthalene	25	4.64		231	1-Isopropylbenzimidazole	25	5.71	
170	4-Fluoroaniline	25	4.65		232	3-Isopropylpyridine	25	5.72	
171	3- <i>tert</i> -Butylaniline	25	4.66		233	2- <i>tert</i> -Butylpyridine	25	5.76	
172	3-Isopropylaniline	25	4.67		234	<i>N</i> -Isopropylaniline	25	5.77	
173	2,3-Dimethylaniline	25	4.70		235	5-Methylbenzimidazole	25	5.78	
174	3-Methylaniline	25	4.70		236	3- <i>tert</i> -Butylpyridine	25	5.82	
175	3-Ethylaniline	25	4.70		237	2-Isopropylpyridine	25	5.83	
176	1,2-Diaminobenzene ( <i>o</i> -Phenylenediamine)	25	4.74	0.6	238	4-Ethylpyridine	25	5.87	
177	<i>N</i> - <i>n</i> -Propylaniline	25	4.79		239	2-Ethylpyridine	25	5.89	
178	Quinoline	25	4.81		240	2-Methylpyridine	25	5.94	
179	3-Aminofluorene	25	4.82		241	4-(Methylthio)pyridine	20	5.94	
180	1-(Dimethylamino)naphthalene	28	4.83		242	2-Hexylpyridine	25	5.95	
181	<i>N</i> -Methylaniline	25	4.848						
182	2,4-Dimethylaniline	25	4.89						

TABLE XXIX. DISSOCIATION CONSTANTS OF  
ORGANIC BASES IN AQUEOUS SOLUTION

(Listed in order of increasing pKa) (Continued)

(The data relates to the acid dissociation constant (Ka) of the conjugate acid (BH<sup>+</sup>) of the listed base (B))

No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>
243	2- <i>n</i> -Propylpyridine	25	5.97		305	Bis(2-hydroxyethyl)amine	25	8.88	
244	4- <i>tert</i> -Butylpyridine	25	5.99		306	N,N-Dimethylbenzylamine	25	8.91	
245	2-Pentylpyridine	25	6.00		307	3-Bromopropylamine	21	8.93	
246	4-Isopropylpyridine	25	6.02		308	1,2-Bis(dimethylamino)ethane	30	8.97	5.85
247	4-Methylpyridine	25	6.03		309	1-(Aminoethyl)benzene	25	9.08	
248	3-Aminopyridine	25	6.03		310	2-Acetoxyethylamine	25	9.1	
249	N,N,2-Trimethylaniline	25	6.11		311	4-Aminopyridine	25	9.114	
250	N,2,6-Trimethylaniline	25	6.12		312	4-Aminoquinoline	20	9.13	
					313	(3-Cyanopropyl) diethyl amine	25	9.13	
252	2-Methylbenzimidazole	25	6.19		314	3-Methoxybenzylamine	25	9.15	
253	1,4-Diaminobenzene ( <i>p</i> -Phenylenediamine)	25	6.2	2.67	315	2-Methylbenzylamine	25	9.19	
254	2-Isopropylbenzimidazole	25	6.21		316	1-Aminoindane	22.5	9.21	
255	2-Ethylbenzimidazole	25	6.27		317	<i>trans</i> -1-Amino-2-hydroxycyclopentane	25	9.28	
256	N,N-Di- <i>n</i> -butylaniline	19	6.30		318	Diallylamine	25	9.29	
257	2,5-Dimethylpyridine	25	6.40		319	Dimethyl (2-hydroxyethyl) amine	20	9.31	
258	2-Phenylimidazole	25	6.40		320	3-Methylbenzylamine	25	9.33	
259	Bis(2-chloroethyl) methyl amine	25	6.43		321	Benzylamine	25	9.35,	
260	4-Methoxyquinoline	30	6.45					(9.62)	
261	3,4-Dimethylpyridine	25	6.46		322	4-Methylbenzylamine	25	9.36	
262	4-Methoxypyridine	25	6.47		323	3,4-Dimethoxybenzylamine	25	9.39	
263	Bis(2-chloroethyl) ethyl amine	25	6.55		324	2,3-Dimethoxybenzylamine	25	9.41	
264	1,2-Dimethylbenzimidazole	25	6.55		325	2-(Phenethylamino)ethylamine	25	9.44	6.59
265	2,3-Dimethylpyridine	25	6.57		326	N,N-Diethylbenzylamine	25	9.44	
266	2,6-Dimethylpyridine	25	6.60		327	4-Methoxybenzylamine	25	9.47	
267	7-Aminoquinoline	20	6.61		328	2-(Methylthio)ethylamine	20	9.49	
268	N,N-Diethylaniline	22	6.61		329	2-Hydroxyethylamine	25	9.498	
269	4-Ethoxypyridine	20	6.67		330	2-(Dimethylamino)ethylamine	25	9.53	6.63
270	2-Aminopyridine	25	6.71		331	N-Methylbenzylamine	25	9.54	
271	2,4-Dimethylpyridine	25	6.77		332	1,2-Bis(diethylamino)ethane	25	9.55	6.18
272	Imidazole	25	6.95		333	2-Aminoindane	21.5	9.57	
273	<i>N-tert</i> -Butylaniline	25	7.00		334	N-Propylbenzylamine	25	9.58	
274	(2-Cyanoethyl) dimethyl amine	29	7.0		335	1,2,3-Triaminopropane	20	9.59	7.95, pK <sub>3</sub> = 3.72
275	2-Benzyl-2-pyrrolone	25	7.06						
276	2-Aminoquinoline	20	7.30		336	2-Methoxyethylamine	20	9.61	
277	N,N-Di-isopropylaniline	25	7.37		337	5-Bromo- <i>n</i> -pentylamine	21	9.62	
278	N-Methylmorpholine	25	7.38		338	<i>trans</i> -1-Amino-2-hydroxycyclohexane	25	9.63	
279	2,4,6-Trimethylpyridine	25	7.43		339	1-Amino-1,2,3,4-tetrahydronaphthalene	20	9.63	
280	4-Methylimidazole	25	7.518		340	N-Ethylbenzylamine	25	9.64	
281	1,3-Triazine	25	7.6		341	3,3,3-Trichloro- <i>n</i> -propylamine	20	9.65	
282	N-Ethylmorpholine	25	7.67		342	1-Allylpiperidine	25	9.65	
283	2-Cyanoethylamine	29	7.7		343	2-Methoxybenzylamine	25	9.70	
284	Tris(2-hydroxyethyl)amine	25	7.762		344	<i>cis</i> -1-Amino-2-hydroxycyclopentane	25	9.70	
285	2-Methylimidazole	25	7.85		345	2-(Furfurylamino)ethylamine	20	9.72	6.20
286	N-Methylaziridine	25	7.86		346	<i>cis</i> -1-Amino-2-hydroxycyclohexane	25	9.72	
287	<i>N-n</i> -Butylaziridine	25	7.86		347	Piperazine	25	9.81	5.55
288	2-Ethyl-2-pyrrolone	25	7.87		348	Trimethylamine	25	9.81	
289	2,3,5,6-Tetramethylpyridine	20	7.90		349	Phenethylamine ((2-Aminoethyl)benzene)	25	9.84	
290	2-Cyclohexyl-2-pyrrolone	25	7.91		350	Diethyl 2-hydroxyethyl amine	20	9.87	
291	N-Ethylaziridine	24	7.93		351	1-Methyl-3-pyrrolone	25	9.88	
292	Aziridine	25	8.01		352	1,2-Diaminoethane (1,2-Ethylenediamine)	25	9.928	6.848
293	N,2-Diethylaziridine	25	8.18		353	<i>cis</i> -1,2-Diaminocyclohexane	20	9.93	6.13
294	2-Ethylaziridine	25	8.29		354	2-Amino-1,2,3,4-tetrahydronaphthalene	17	9.93	
295	Triallylamine	25	8.31		355	Tri- <i>n</i> -butylamine	25	9.93	
296	Morpholine	25	8.33		356	4,4,4-Trichloro- <i>n</i> -butylamine	20	9.93	
297	2,4-Dimethylimidazole	25	8.36		357	<i>trans</i> -1,2-Diaminocyclohexane	20	9.94	6.47
298	2-Bromoethylamine	24	8.49		358	3-Hydroxypropylamine	25	9.96	
299	Bis(2-hydroxyethyl) methyl amine	25	8.52		359	<i>meso</i> -2,3-Diaminobutane	25	9.97	6.92
300	1,2-Bis(furfurylamino)ethane	20	8.61	5.74	360	<i>d,l</i> -2,3-Diaminobutane	25	10.00	6.91
301	2,2-Dimethylaziridine	25	8.64		361	1,2-Diaminopropane	25	10.00	7.13
302	<i>trans</i> -2,3-Dimethylaziridine	24	8.69						
303	<i>cis</i> -2,3-Dimethylaziridine	23	8.72		362	<i>cis</i> -Neobornylamine	25	10.01	
304	(2-Chloroethyl) diethyl amine	25	8.80						



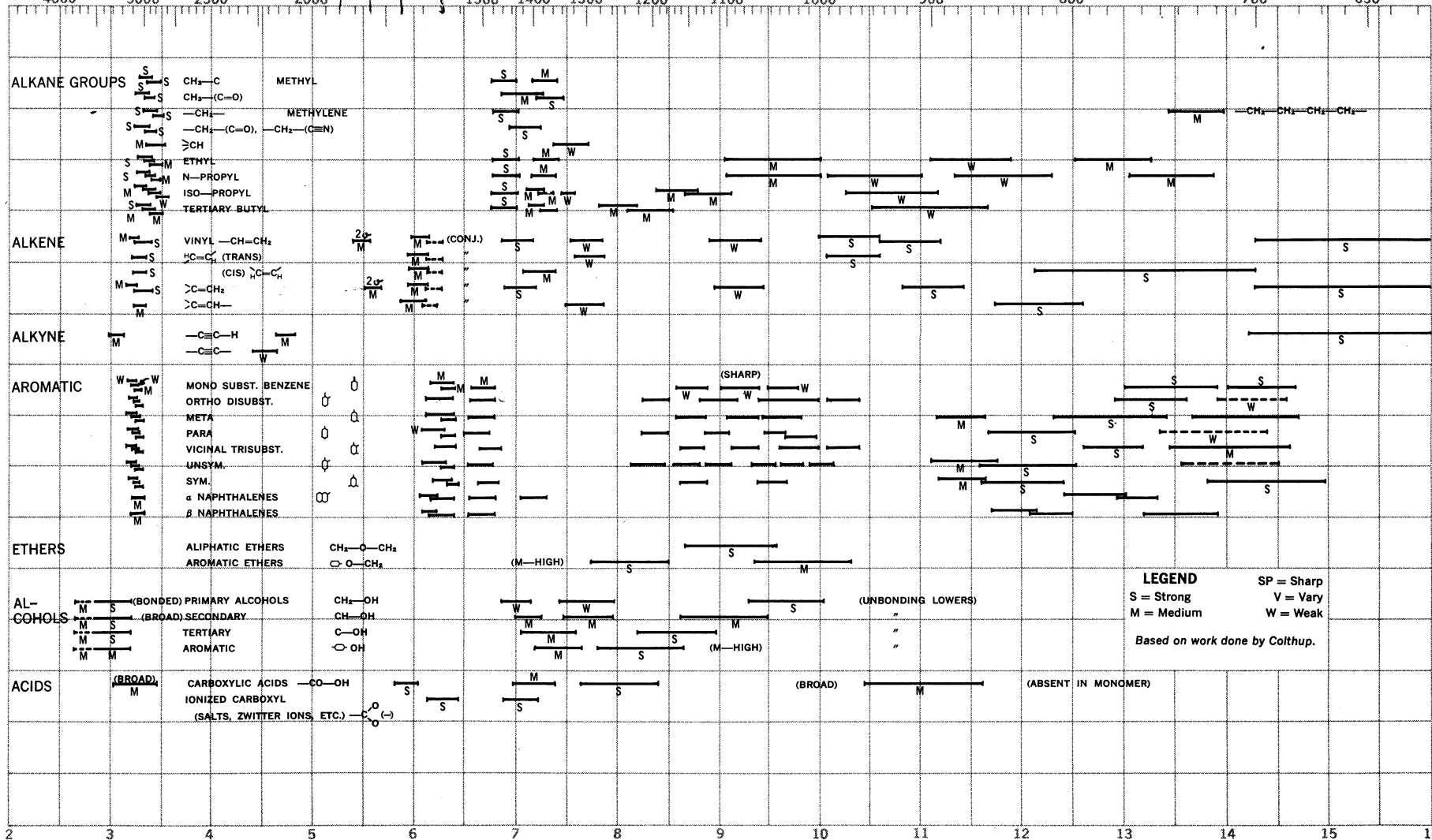
TABLE XXIX. DISSOCIATION CONSTANTS OF ORGANIC BASES IN AQUEOUS SOLUTION

(Listed in order of increasing pK<sub>a</sub>) (Continued)

(The data relates to the acid dissociation constant (K<sub>a</sub>) of the conjugate acid (BH<sup>+</sup>) of the listed base (B))

No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>
363	2-(Diethylamino)ethylamine	25	10 02	7 07	417	<i>n</i> -Pentylamine	25	10 63	
364	1-Methylpiperidine	25	10 08		418	<i>n</i> -Undecylamine ( <i>n</i> -Hendecylamine)	25	10 63	
365	Dimethyl isobutyl amine	20	10 08		419	<i>n</i> -Nonylamine	25	10 64	
366	5,5,5-Trichloro- <i>n</i> -pentylamine	20	10 12		420	Acridine	25	10 65	
367	2-(Methylamino)ethylamine	20	10 15	6 86	421	<i>n</i> -Octylamine	25	10 65	
368	<i>cis</i> -1,2,6-Trimethylpiperidine	30	10 15		422	Methylamine	25	10 657	
369	2,2-Dimethyl- <i>n</i> -propylamine	25	10 15		423	1-Ethyl-2-methylpiperidine	25	10 66	
370	1,2-Bis(methylamino)ethane	25	10 16	7 40	424	<i>n</i> -Heptylamine	25	10 66	
371	Dimethyl propyl amine	20	10 16		425	2-Aminoheptane	25	10 67	
372	Dimethyl ethyl amine	20	10 16		426	Cyclohexylamine	25	10 68	
373	<i>trans</i> -Bornylamine	25	10 17		427	<i>tert</i> -Butylamine	25	10 68	
374	1,2,2,4-Tetramethylpiperidine	30	10 18		428	<i>tert</i> -Butyl dimethyl amine	20	10 69	
375	<i>n</i> -Butyl dimethyl amine	25	10 19		429	<i>n</i> -Propylamine	25	10 69	
376	1,2-Dimethylpyrrolidine	26	10 20		430	1,2,2,6-Tetramethylpiperidine	30	10 70	
377	1,2-Dimethylpiperidine	25	10 22		431	Ethylamine	25	10 70	
378	1,5-Diaminopentane	25	10 25	9 13	432	Isobutylamine	25	10 72	
379	Tri- <i>n</i> -propylamine	25	10 26		433	3-(Trimethylsilyl)- <i>n</i> -propylamine	25	10 73	
380	1,2-Bis(propylamino)ethane	25	10 27	7 53	434	Dimethylamine	25	10 73	
381	2-(Butylamino)ethylamine	25	10 30	7 53	435	Triethylamine	25	10 75	
382	1,3-Diaminopropane (1,3-Propylenediamine)	25	10 30	8 29	436	2-Cyclohexylpyrrolidine	25	10 76	
383	2-Benzylpyrrolidine	25	10 31		437	1,4-Diaminobutane	20	10 80	9 35
384	Tri-isobutylamine	25	10 32		438	Di-isobutylamine	21	10 91	
385	<i>N</i> -Methylpyrrolidine	25	10 32		439	1,6-Diaminohexane	25	10 93	9 83
386	2-(propylamino)ethylamine	25	10 34	7 54	440	Di-isoamylamine	27 8	10 94	
387	4-Hydroxy- <i>n</i> -butylamine	20	10 35		441	Quinuclidine	25	10 95	
388	1,2-Bis(isopropylamino)ethane	25	10 40	7 59	442	2-Methylpiperidine	25	10 95	
389	1- <i>n</i> -Propylpiperidine	26 5	10 41		443	2-(Trimethylsilyl)ethylamine	25	10 97	
390	3-Aminopentane	25	10 42		444	Di- <i>n</i> -tridecylamine	25	11 00	
391	3-Aminocyclohexane	25	10 42		445	Di- <i>n</i> -octadecylamine	25	11 00	
392	1- <i>n</i> -Butylpiperidine	26	10 43		446	1,8-Diaminooctane	20	11 00	10 1
393	1-Ethylpiperidine	23	10 45		447	Di- <i>n</i> -propylamine	25	11 00	
394	1,2-Bis(ethylamino)ethane	25	10 46	7 70	448	Di- <i>n</i> -dodecylamine	25	11 00	
395	Diethyl methyl amine	20	10 46		449	Di- <i>n</i> -pentadecylamine	25	11 00	
396	5-Hydroxy-1-pentylamine	23	10 46		450	Di- <i>n</i> -hexylamine	25	11 01	
397	Dimethyl isopropyl amine	20	10 47		451	Di- <i>n</i> -octylamine	25	11 01	
398	<i>trans</i> -1-Amino-4-methylcyclohexane	25	10 48		452	2,2,4-Trimethylpiperidine	30	11 04	
399	(Aminomethyl)cyclohexane	25	10 49		453	Cyclohexyl methyl amine	25	11 04	
400	<i>cis</i> -1-Amino-2-methylcyclohexane	25	10 49		454	Diethylamine	25	11 04	
401	2-Aminooctane	25	10 49		455	2,2,6,6-Tetramethylpiperidine	25	11 07	
402	<i>trans</i> -1-Amino-2-methylcyclohexane	25	10 51		456	Azepine	25	11 07	
403	<i>cis</i> -1-Amino-3-methylcyclohexane	25	10 56		457	<i>cis</i> -2,6-Dimethylpiperidine	25	11 07	
404	2-(Ethylamino)ethylamine	25	10 56	7 63	458	3-Methylpiperidine	25	11 07	
405	Dimethyl <i>sec</i> -butyl amine	20	10 57		459	Piperidine	25	11 123	
406	6-Hydroxy- <i>n</i> -hexylamine	21	10 60		460	Di-isopropylamine	21	11 13	
407	6-Bromo- <i>n</i> -hexylamine	21	10 60		461	Di- <i>n</i> -pentylamine	26	11 16	
408	1-Aminoheptadecane	25	10 60		462	2,2,6-Trimethylpiperidine	30	11 21	
409	1-Aminodocosane	25	10 60		463	( <i>tert</i> -Butylamino)cyclohexane	25	11 23	
410	1-Aminooctadecane	25	10 60		464	Di- <i>n</i> -butylamine	25	11 25	
411	1-Aminopentadecane	25	10 61		465	1,2,2,4,4-Pentamethylpiperidine	25	11 25	
412	<i>n</i> -Butylamine	25	10 61		466	Pyrrolidine	25	11 27	
413	1-Aminohexadecane	25	10 61		467	Azetidine	25	11 29	
414	<i>trans</i> -1-Amino-3-methylcyclohexane	25	10 61		468	Isopropylamine	25	11 54, (10 63)	
415	1-Aminotetradecane	25	10 62		469	1,2-Dimethyl-2-pyrrolone	25	11 90	
416	2-(Isopropylamino)ethylamine	25	10 62	7 70	470	Acetamidine (Methylamidine)	25	12 40	

4000 3000 2500 2000 1500 1400 1300 1200 1100 1000 900 800 700 650



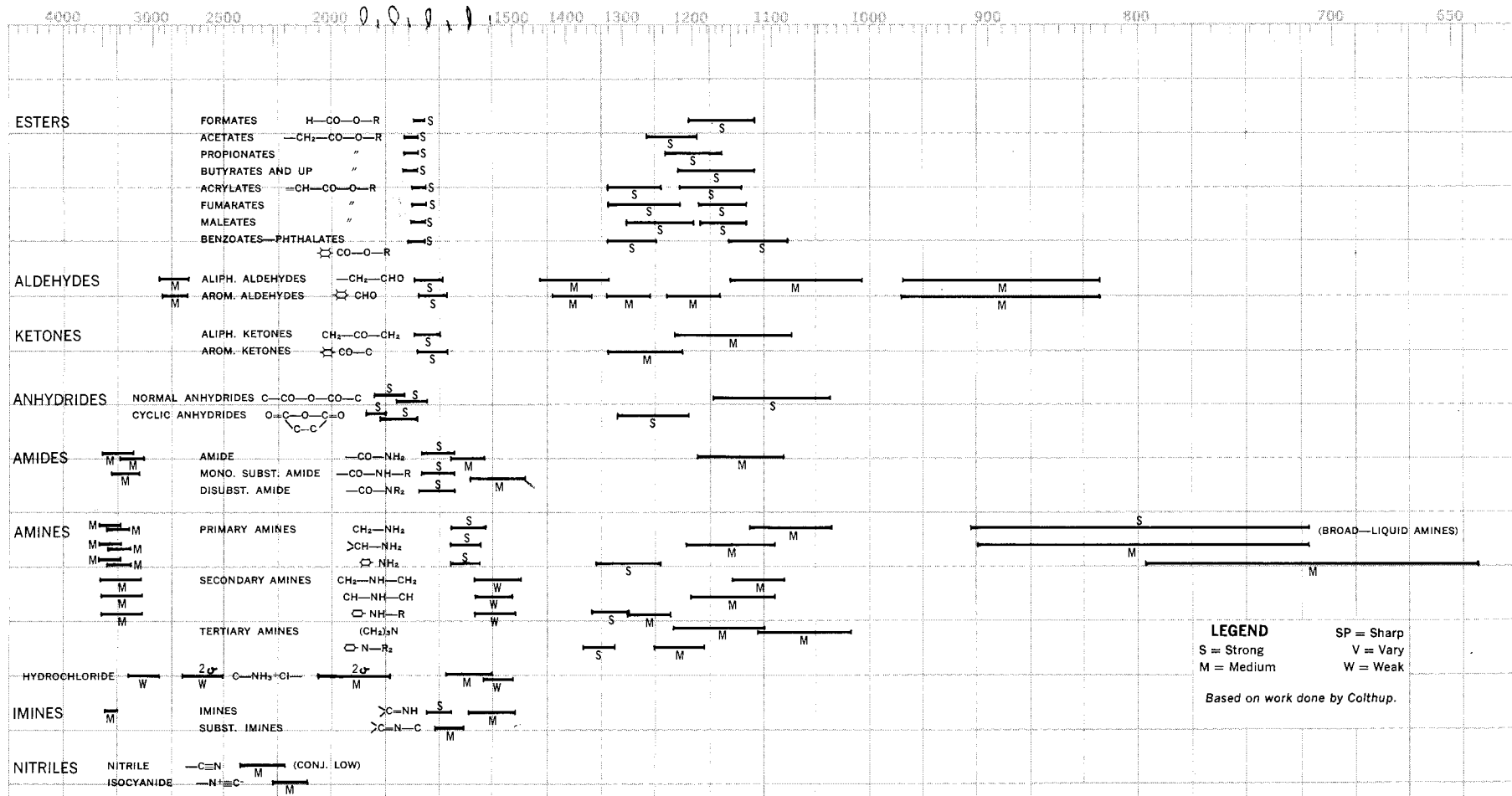
WAVELENGTH IN MICRONS

Handbook of tables for Organic Compound Identification, © 1967 CRC

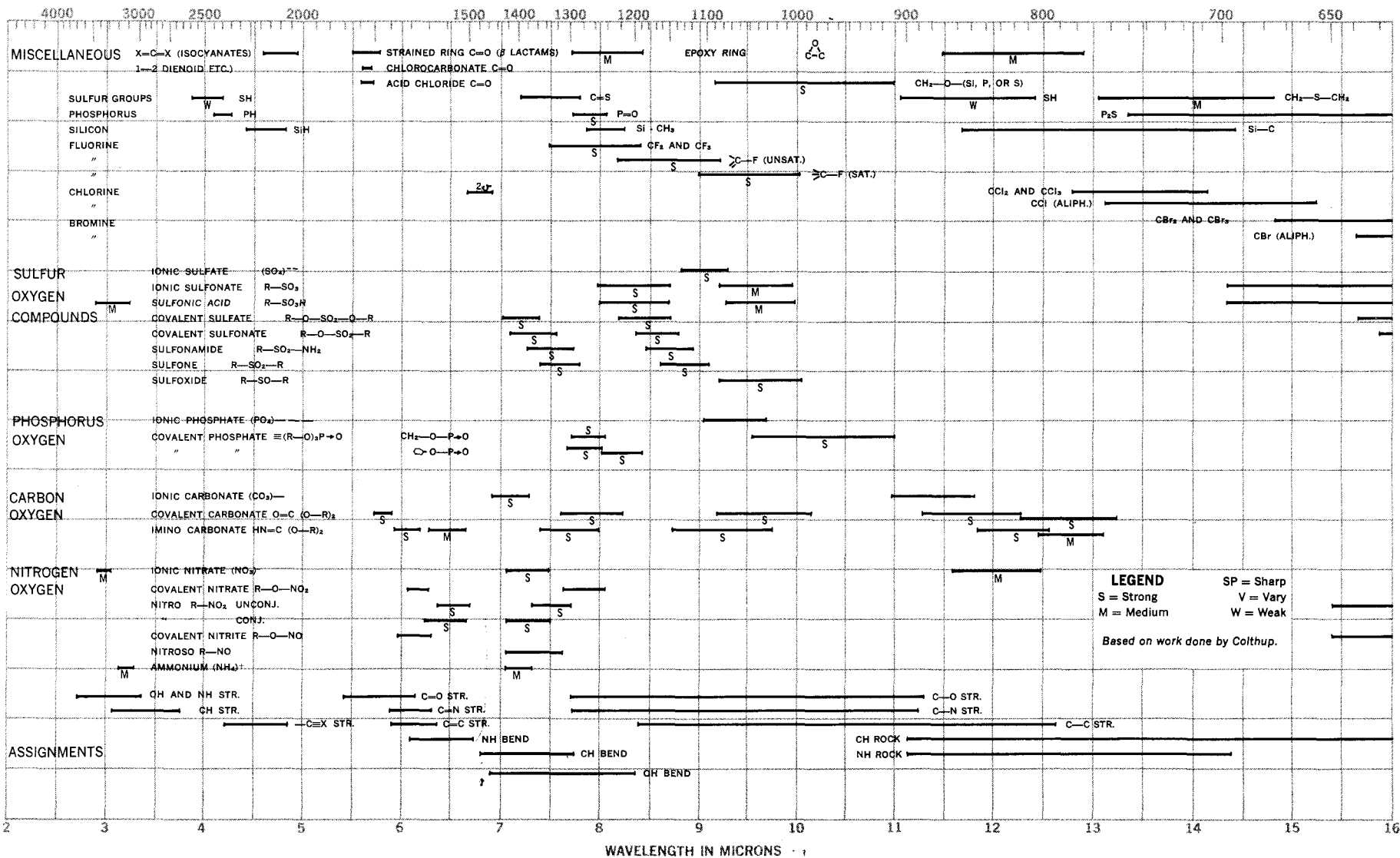
441

# INFRARED CORRELATION CHART No. 1 (Con't.)

WAVENUMBERS IN KAYSERS



WAVENUMBERS IN KAYSERS



443

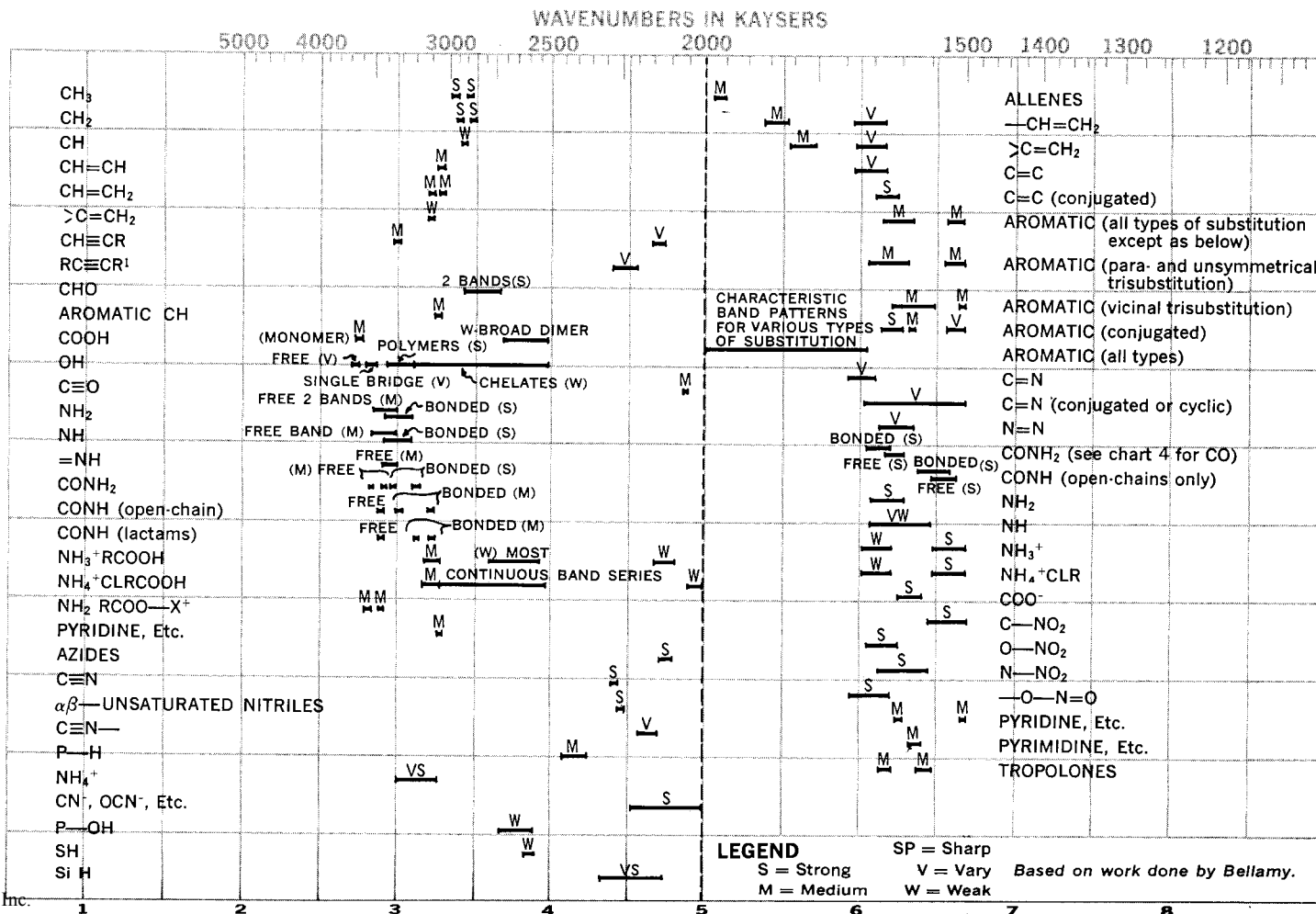
# INFRARED CORRELATION CHART No. 2

Prepared from information supplied by Beckman Instruments

This chart presents some information regarding structure, double-bond vibrations, hydrogen stretching and triple-bond vibrations.

HYDROGEN STRETCHING AND TRIPLE-BOND VIBRATIONS, 3750-2000 CM.<sup>-1</sup>

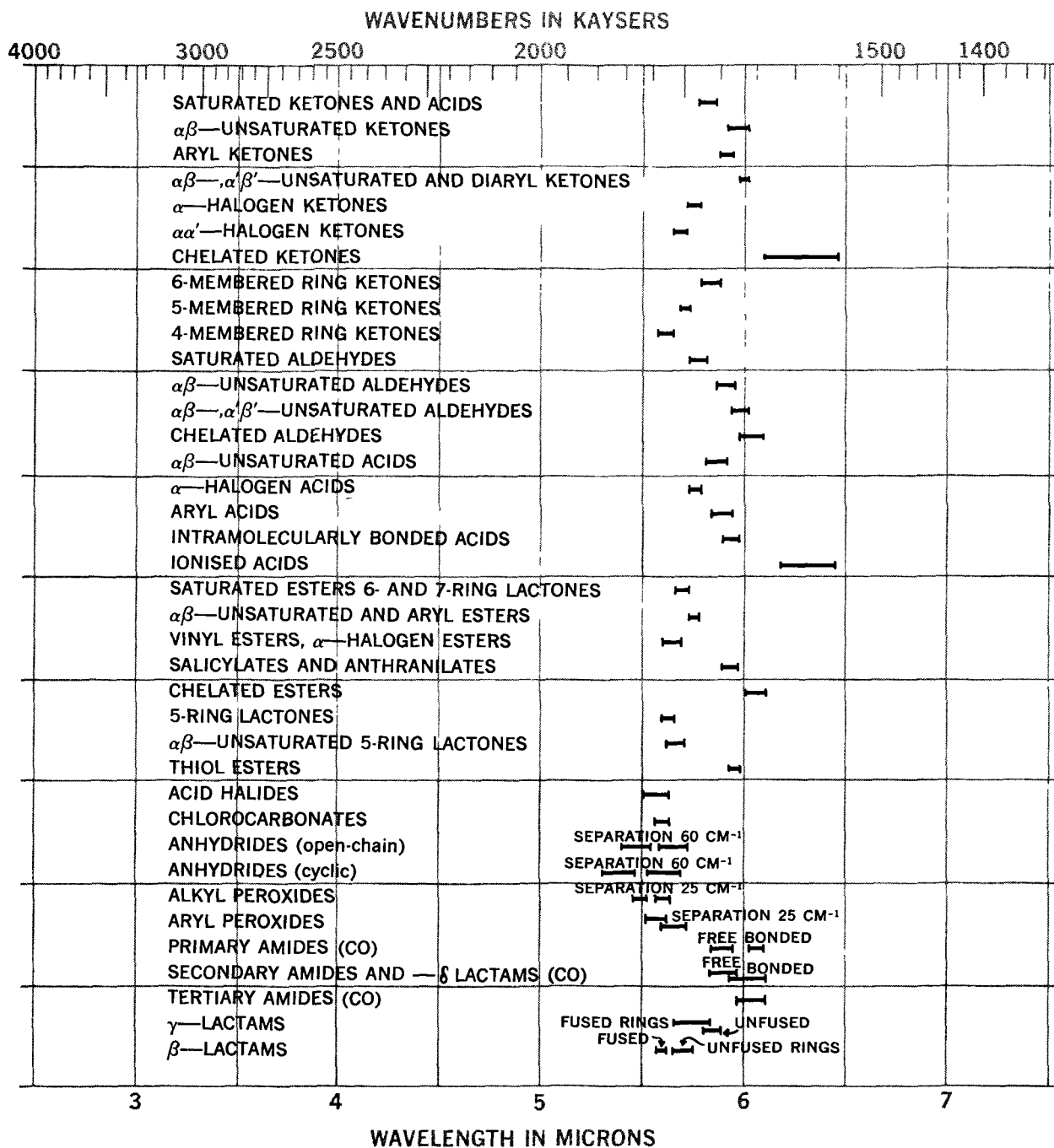
DOUBLE-BOND VIBRATIONS, ETC. 2000-1500 CM.<sup>-1</sup>



### INFRARED CORRELATION CHART No. 3

Prepared from information supplied by Beckman Instruments

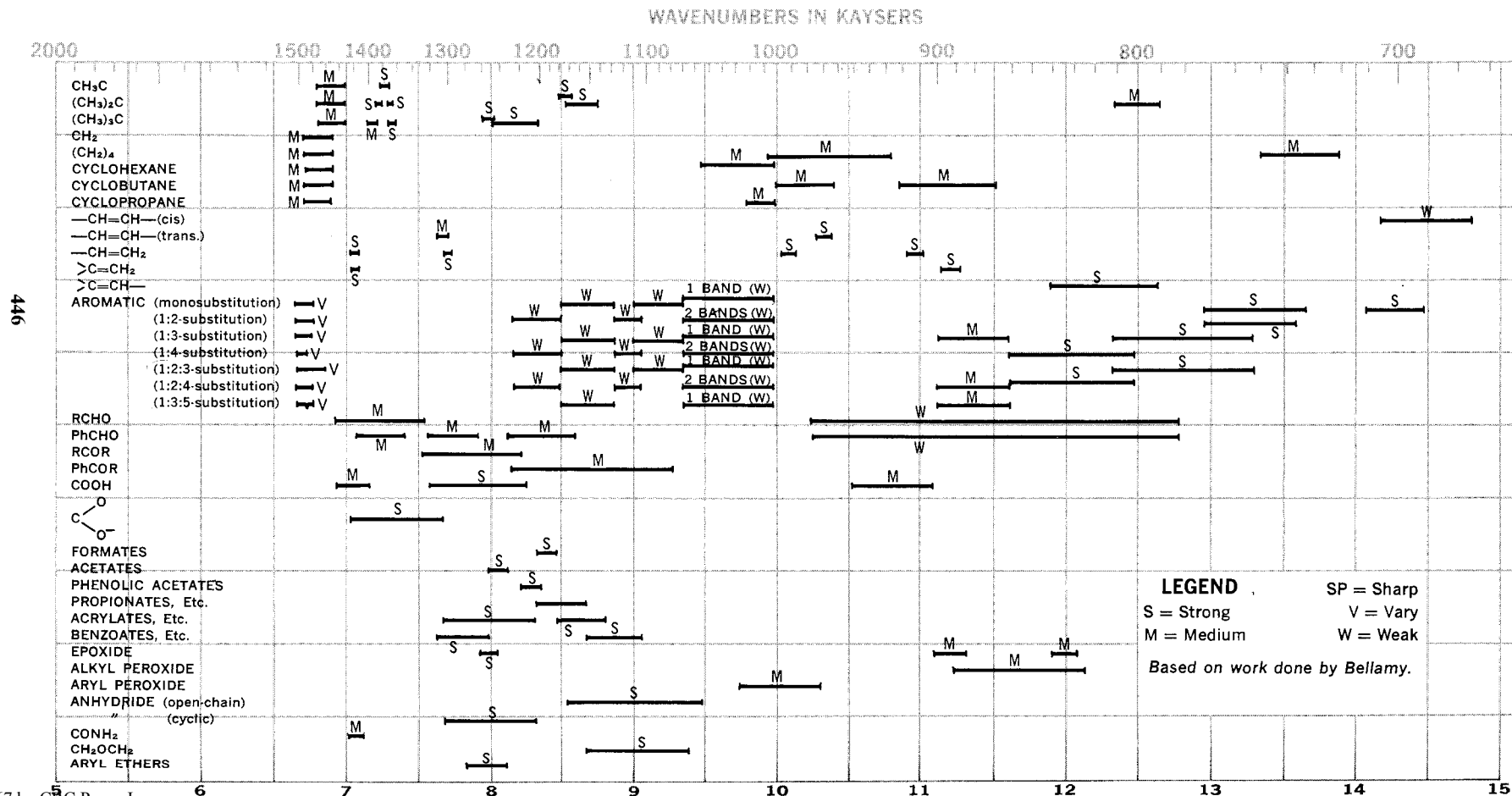
This chart presents some correlations between structure and the carbonyl vibrations of some classes of organic compounds. In all cases the absorption bands are strong and fall within the range of 1900-1500  $\text{cm}^{-1}$ .



# INFRARED CORRELATION CHART No. 4

Prepared from information supplied by Beckman Instruments

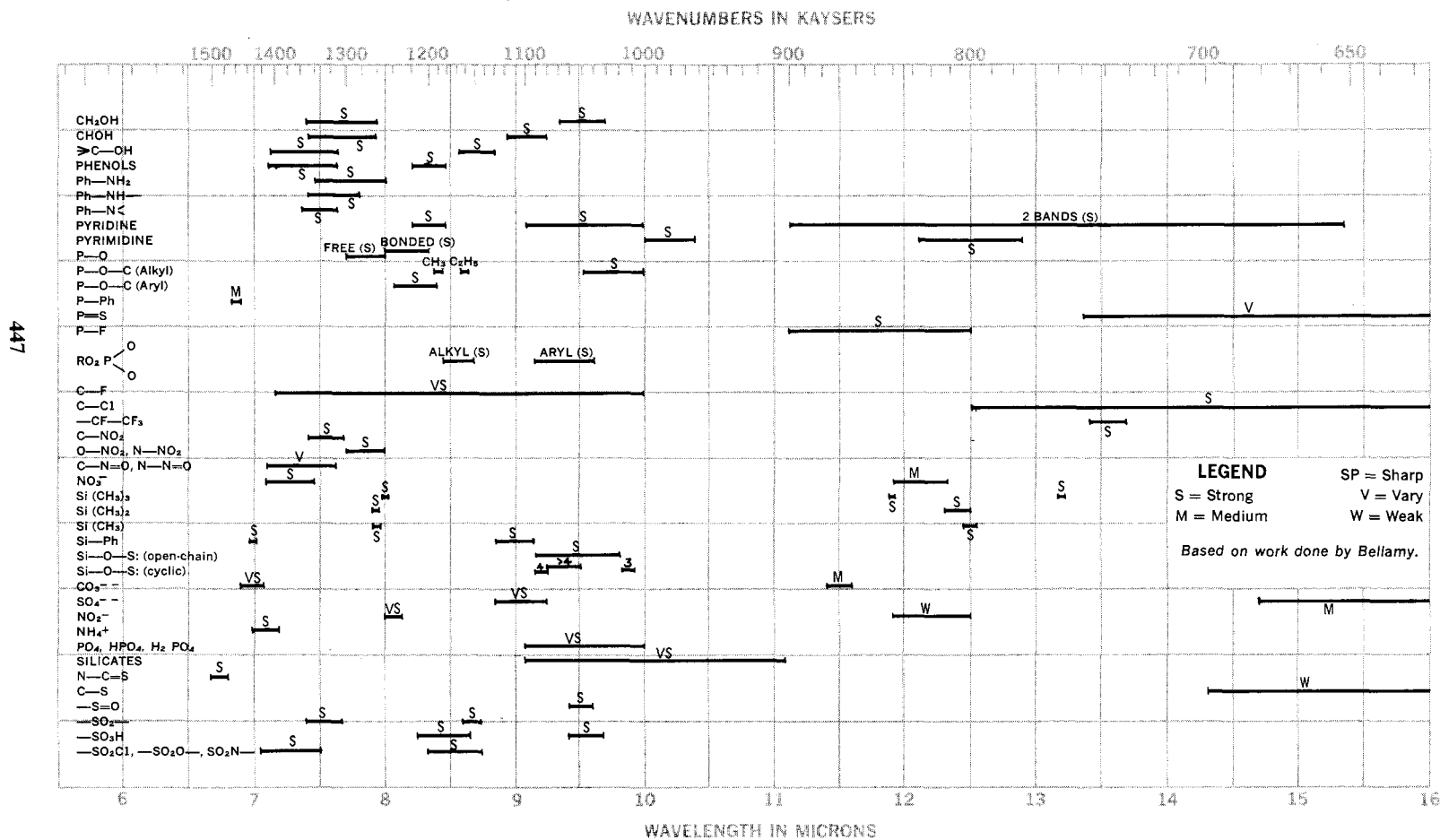
This chart presents some correlations between structure and single-bond vibrations for a number of classes of compounds having absorption between 1500-650  $\text{cm}^{-1}$ .



# INFRARED CORRELATION CHART No. 4 (Con't.)

Prepared from information supplied by Beckman Instruments

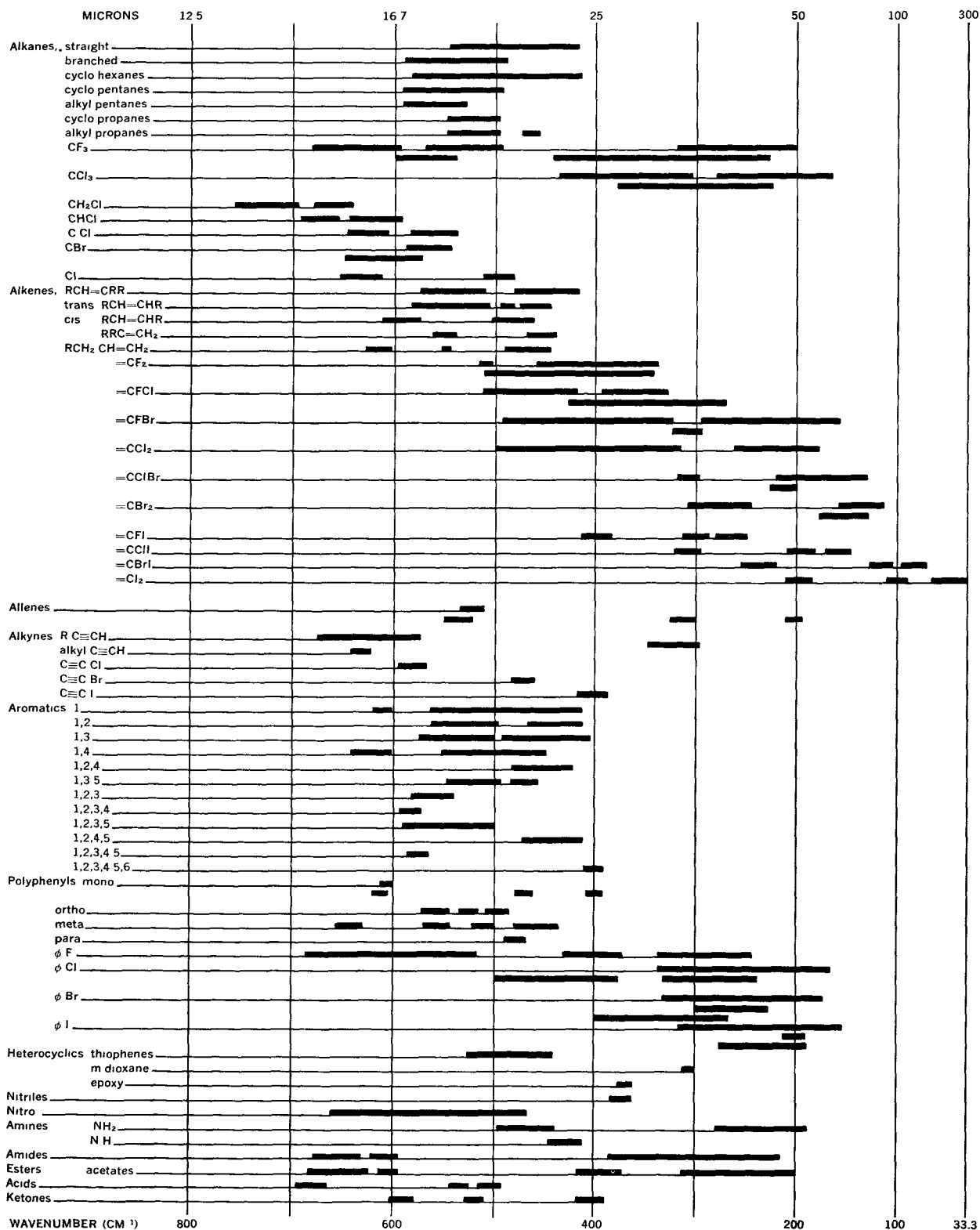
This chart presents some correlations between structure and single-bond vibrations for a number of classes of compounds having absorption between 1500-650  $\text{cm}^{-1}$ .



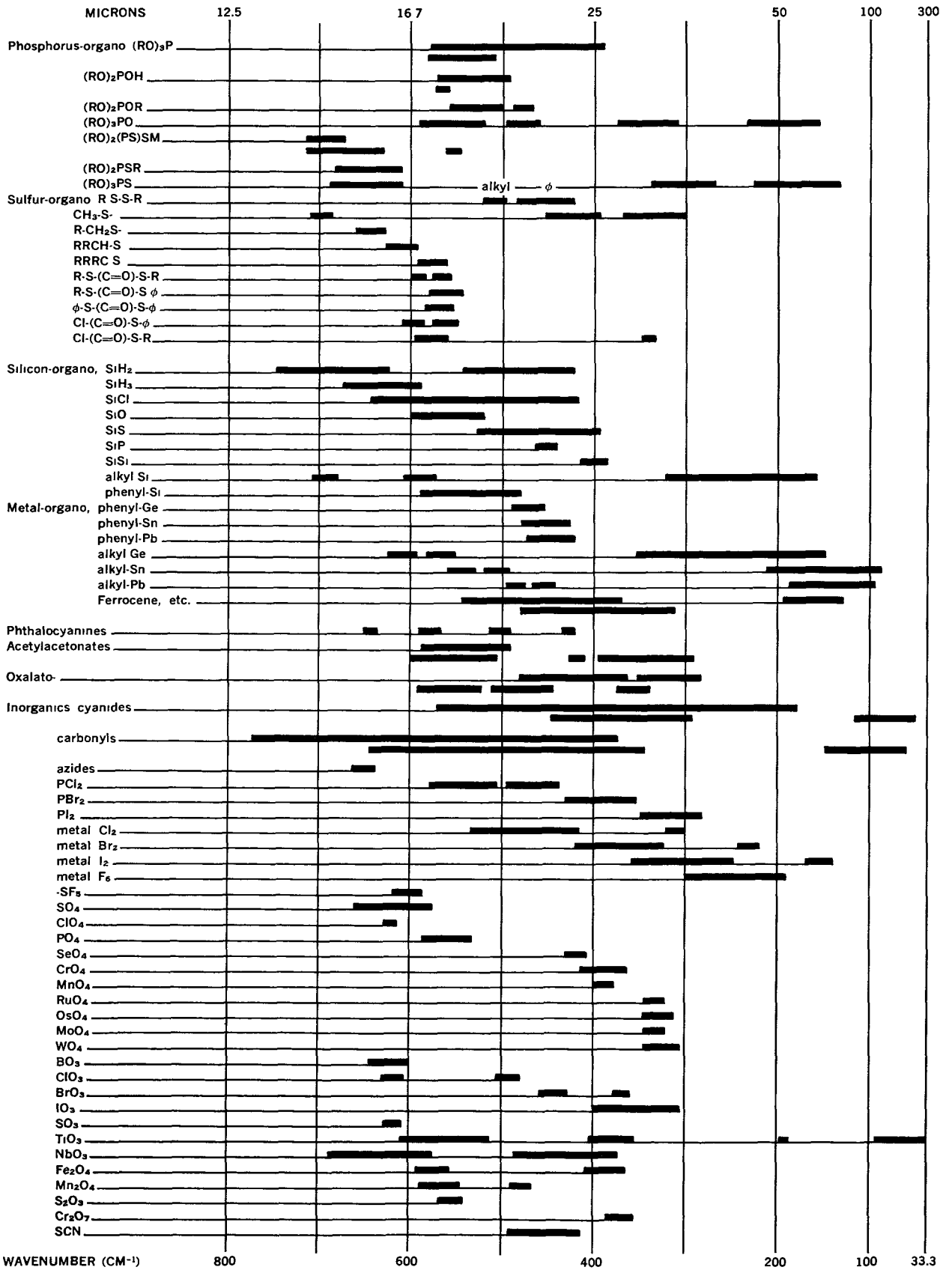


## FAR INFRARED VIBRATIONAL FREQUENCY CORRELATION CHART

Based on evidence compiled by James E. Stewart of Beckman Instruments.  
 This chart shows the vibrational frequency correlation in the far infrared region.  
 Because research is continuing in the far infrared region, this chart is not all-inclusive.



# FAR INFRARED VIBRATIONAL FREQUENCY CORRELATION CHART (Con't.)





## MISCIBILITY OF ORGANIC SOLVENT PAIRS

Table A

Doctor J. S. Drury

Industrial and Engineering Chemistry

Vol. 44, No. 11, Nov. 1952

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The classifications were made by shaking together 5 ml. of each of the solvents listed in a test tube for 1 minute, then allowing the mixture to settle. If no interfacial meniscus was observed, the solvent pair was considered miscible. If such a meniscus was present, the solvent pair was regarded as immiscible. The classification of immiscible is a qualitative one since solvent pairs may exhibit some degree of partial miscibility while existing as separate phases. Solvent pairs possessing a pronounced degree of partial miscibility are designated by the symbol Is.

Compound number	Compounds	Acetone	Acetyl acetone	2-Amino-2-methyl-1-propanol	Aniline	Benzaldehyde	Benzene	Benzin	Benzyl alcohol	Butyl acetate	Butyl alcohol	n-Butyl ether	Capryl alcohol	Carbon tetrachloride	Diacetone alcohol	Diethanolamine	Diethyl cellosolve	Diethyl ether	Dimethylaniline	Ethyl alcohol	Ethyl benzoate	Ethylene glycol	2-Ethylhexanol	Formamide	Furfuryl alcohol	Glycerol	Hydroxyethyl-ethylenediamine	Isoamyl alcohol	Methyl isobutyl ketone	Nitromethane	Dibutoxytetra-ethylene glycol	Pyridine	Triethanolamine	Trimethylene glycol			
1	Acetone	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
2	Acetyl acetone	M	R	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	M	M	M	M	M	M	M	M	M	R	M	M	M	M	M	M	M	M	
3	Adiponitrile	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
4	2-Amino-2-methyl-1-propanol	M	R	M	M	M	M	M	M	M	M	Is	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
5	Benzaldehyde	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	Is	M	M	M	M	M	M	M	M	M	M	M	M	M	M
6	Benzene	M	M	M	M	M	M	M	M	M	M	M	M	M	Is	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
7	Benzin	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
8	Benzonitrile	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
9	Benzothiazole	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
10	Benzyl alcohol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
11	Benzyl mercaptan	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
12	Butyl acetate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
13	Butyl alcohol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
14	n-Butyl ether	M	M	Is	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
15	Capryl alcohol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
16	Carbon tetrachloride	M	M	M	M	M	M	M	M	M	M	M	M	Is	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
17	Diacetone alcohol	M	M	R	M	Is	M	M	M	M	M	M	M	Is	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
18	Diethanolamine	M	R	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
19	Diethyl Cellosolve	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
20	Diethyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
21	Dimethylaniline	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
22	Di-N-propylaniline	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
23	Ethyl alcohol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
24	Ethyl benzoate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
25	Ethyl isothiocyanate	M	M	R	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
26	Ethyl thiocyanate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
27	Ethylene glycol	M	M	M	M	Is	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
28	2-Ethylhexanol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
29	Formamide	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
30	Furfuryl alcohol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
31	Glycerol	I	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
32	Hydroxyethyl-ethylenediamine	M	R	M	M	R	I	Is	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
33	Isoamyl alcohol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
34	Isoamyl sulfide	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
35	Isobutyl mercaptan	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
36	Methyl disulfide	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
37	Methyl isobutyl ketone	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
38	Nitromethane	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
39	Dibutoxytetra-ethylene glycol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
40	Pyridine	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
41	Tri-n-butylamine	M	M	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
42	Trimethylene glycol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M

# MISCIBILITY OF ORGANIC SOLVENT PAIRS (Continued)

Tables B and C

W. M. Jackson and J. S. Drury

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The classifications were made at 20°C in the following manner: One-milliliter portions of each solvent comprising a pair were shaken together for approximately a minute. If no interfacial meniscus was observed after the contents of the tube were allowed to settle, the solvent pair was considered to be miscible, M. If a meniscus was observed without apparent change in the volume of either solvent, the pair was regarded as immiscible, I. This classification is a qualitative one since solvent pairs may exhibit various degrees of partial miscibility while existing as separate phases. If an obvious change occurred in the volume of each solvent but a meniscus was present, the pair was classified as partially miscible, S. The designation R indicates that the two solvents reacted.

**Table B**

Compound number	Compounds	Acetone	Isoamyl acetate	n-Amyl cyanide	Benzene	Benzyl ether	2-Bromoethyl acetate	Chloroform	Cinnamaldehyde	Di-n-amyllamine	Di-n-butyl carbonate	Diethylacetic acid	Diethylenetriamine	Diethyl formamide	Dusobutyl ketone	Dusopropylamine	Di-n-propyl aniline	Ethyl alcohol	Ethyl benzoate	Ethyl ether	Ethyl phenylacetate	Heptadecanol <sup>a</sup>	3-Heptanol	n-Heptyl acetate	n-Hexyl ether	Methyl isopropyl ketone	4-Methyl-n-valeric acid	o-Phenetidine	Sulfuric acid (concd)	Tetradecanol <sup>a</sup>	Tri-n-butyl phosphate	Triethylene glycol	Triethylenetetramine	2,6,8-Trimethyl 4-nonanone	Compound number			
1	Acetone		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	1
2	Isoamyl acetate	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	2	
3	n-Amyl cyanide	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	3	
4	Benzene	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	4	
5	Benzyl ether	M	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	5	
6	2-Bromoethyl acetate	M	M	M	S	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	S	M	M	M	M	M	M	M	M	M	M	M	M	M	6
7	Chloroform	M	M	M	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	7
8	Cinnamaldehyde	M	M	M	M	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	8
9	Di-n-amyllamine	M	M	M	M	M	R	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	9
10	Di-n-butyl carbonate	M	M	M	M	M	M	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	10
11	Diethylacetic acid	M	M	M	M	M	M	M	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	11
12	Diethylenetriamine	M	M	M	M	M	M	R	I	M	M	R		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	12
13	Diethyl formamide	M	M	M	M	M	M	M	M	R	M	R	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	13
14	Dusobutyl ketone	M	M	M	M	M	M	M	M	M	M	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	14
15	Dusopropylamine	M	M	M	M	M	M	M	M	M	M	M	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	15
16	Di-n-propylamine	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	16
17	Ethyl alcohol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	17
18	Ethyl benzoate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	18
19	Ethyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	19
20	Ethyl phenylacetate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	20
21	Heptadecanol <sup>a</sup>	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	21
22	3-Heptanol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	22
23	n-Heptyl acetate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	23
24	n-Hexyl ether	M	M	M	M	M	S	M	M	M	M	M	I	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	24
25	Methyl isopropyl ketone	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	25
26	4-Methyl-n-valeric acid	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	26
27	o-Phenetidine	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	27
28	Sulfuric acid (concd)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	28
29	Tetradecanol <sup>a</sup>	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	29
30	Tri-n-butyl phosphate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	30
31	Triethylene glycol	M	I	M	S	I	M	M	S	I	I	M	M	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	31
32	Triethylenetetramine	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	32
33	2,6,8-Trimethyl 4-nonanone	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	33

<sup>a</sup> Union Carbide name.

MISCIBILITY OF ORGANIC SOLVENT  
PAIRS (Continued)

Table C

Compound number	Compounds	Acetone	Isosamyl acetate	n-Amyl cyanide	Anisaldehyde	Benzene	Benzyl ether	Chloroform	o-Cresol	Diisobutyl ketone	Diethylacetic acid	Diethyl formamide	Di-n-propyl aniline	Ethyl alcohol	Ethyl ether	3-Heptanol	n-Heptyl acetate	n-Hexyl ether	α-Methylbenzylamine	α-Methylbenzyl/diethanolamine	α-Methylbenzyl/dimethylamine	2-Methyl-5-ethylpyridine	Methyl isopropyl ketone	4-Methyl-n-valeric acid	o-Phenetidine	2-Phenylethylamine	Isopropanolamine	Pyridine	Salicylaldehyde	Tetradecanol*	Tri-n-butyl phosphate	Triethylentetramine	2,6,8-Trimethyl 4-nonanone			
1	1,3-Butylene glycol	M	I	M	I	I	I	M	M	I	M	M	I	M	S	M	I	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	
2	2,3-Butylene glycol	M	M	M	M	S	I	M	M	M	M	M	I	M	M	M	M	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I
3	2-Chloroethanol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	M	R	M	M	M	M	R	R	M	M	M	M	M	M	
4	3-Chloro-1,2-propanediol	M	M	M	M	I	M	M	M	M	M	M	I	M	M	M	M	I	R	M	M	M	M	M	M	M	R	R	M	M	S	M	R	S		
5	Dibutyl hydrogen phosphite	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
6	Diethylene glycol dibutyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	S	M	M	M	M	M	R	R	M	M	M	M	M	R	M	
7	Diethylene glycol diethyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
8	Diethylene glycol monobutyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
9	Diethylene glycol monoethyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
10	Diethylene glycol monomethyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
11	Dipropylene glycol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
12	Ethylene diacetate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
13	Ethylene glycol	M	I	I	I	I	I	S	M	I	M	M	I	M	I	M	I	I	M	M	M	M	M	I	M	M	M	M	M	M	I	I	S	M	I	
14	Ethyl glycol ethylbutyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
15	Ethylene glycol monobutyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
16	Ethylene glycol monoethyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
17	Ethylene glycol monomethyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
18	Ethylene glycol monophenyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
19	Glycerol	I	I	I	I	I	I	I	M	I	I	M	I	M	I	I	I	I	M	M	I	M	M	I	I	I	I	M	M	M	I	I	I	M	I	
20	1,2-Propanediol	M	M	M	M	I	I	M	M	I	M	M	I	M	S	M	I	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I
21	1,3-Propanediol	M	I	I	I	I	I	M	M	I	M	M	I	M	I	M	I	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I
22	Triethylene glycol	M	I	M	M	S	I	M	M	I	M	M	I	M	I	M	I	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	M	M
23	Triethyl phosphate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
24	Trimethylene chlorohydrin	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	M	R	M	M	R	R	M	M	M	M	M	R	M	M	

\* Union Carbide name.

### EMERGENT STEM CORRECTION FOR LIQUID-IN-GLASS THERMOMETERS

Accurate thermometers are calibrated with the entire stem immersed in the bath which determines the temperature of the thermometer bulb. However, for reasons of convenience it is common practice when using a thermometer to permit its stem to extend out of the apparatus. Under these conditions both the stem and the mercury in the exposed stem are at a temperature different from that of the bulb. This introduces an error into the observed temperature. Since the coefficient of thermal expansion of glass is less than that of mercury, the observed temperature will be less than the true temperature if the bulb is hotter than the stem and greater than the true temperature, providing the thermal gradient is reversed. For exact work the magnitude of this error can only be determined by experiment. However, for most purposes it is sufficiently accurate to apply the following equation which takes into account the difference of the thermal expansion of glass and mercury:

$$T_c = T_o + F \times L(T_o - T_m)$$

Where  $T_c$  = corrected temperature

$T_o$  = observed temperature

$T_m$  = mean temperature of exposed stem. The mean temperature of the exposed stem may be determined by fastening the bulb of a second thermometer against the mid-point of the exposed liquid column.

$L$  = the length of the exposed column in degrees above the surface of the substance whose temperature is being determined.

$F$  = correction factor. For approximate work and when the liquid in the thermometer is mercury a value for  $F$  of 0.00016 is generally used. For more accurate work with mercury filled thermometers values as given in the following table are used. For thermometers filled with organic liquids it is customary to use 0.001 for the value of  $F$ .

Values of F for various glasses					
$T_m$ °C.	Corning 0041	Corning 8800	Corning 8810	Jena 16 III	Jena 59 III
50	0.000157	0.000166	0.000156	0.000158	0.000164
150	0.000159	0.000167	0.000157	0.000158	0.000165
250	0.000163	0.000168	0.000161	0.000161	0.000170
350	0.000168	0.000173	0.000166	.....	0.000177

## CORRECTION OF BOILING POINTS TO STANDARD PRESSURE

BY H. B. HASS AND R. F. NEWTON

This correction may be made by using the equation:

$$\Delta t = \frac{(273.1 + t)(2.8808 - \log p)}{\phi + .15(2.8808 - \log p)} \quad (1)$$

where  $\Delta t$  = degrees C to be added to the observed boiling point.

$t$  = the observed boiling point.

$\log p$  = the logarithm of the observed pressure in millimeters of mercury.

$\phi$  = the entropy of vaporization at 760 mm.

The value of  $\phi$  may be estimated from the graph and the table. Substances not included in the table may be classified by grouping them with compounds which bear a close physical or structural resemblance to them.

Example 1. Benzene boils at 20°C. at 75 mm pressure. What is its normal boiling point? We do not find benzene in the table but we find hydrocarbons in group 2, and a group 2 compound with a boiling point of 20° has a  $\phi$  of 4.6.

Substituting in the equation

$$\Delta t = \frac{(273.1 + 20)(2.8808 - 1.8751)}{4.60 + .15(2.8808 - 1.8751)} = 62^\circ$$

Adding this to 20° gives 82° as a first approximation.

The graph shows that the  $\phi$  for a compound of group 2 boiling at 82° is 4.72 instead of 4.60 which we originally used. Since  $\phi$  is in the denominator, this increase will lower our  $\Delta t$  by the ratio, 4.60/4.72, or the corrected  $\Delta t$  is  $62 \times 4.60/4.72 = 60.4$ . Adding  $\Delta t$  to  $t$ , gives 80.4° as a second approximation.

The formula can best be used in a slightly different form when the reverse calculation is desired, *i.e.*, when one calculates the vapor pressure at a given temperature, lower than the normal boiling point.

$$2.8808 - \log p = \frac{\phi \Delta t}{273.1 + t - .15 \Delta t} \quad (2)$$

Example 2. Alcohol boils at 78.4°C. What is its vapor pressure at 20°C.? Substituting in equation 2:

$$2.8808 - \log p = \frac{6.06 \times 58.4}{293.1 - (.15 \times 58.4)} = 1.245$$

$$\log p = 2.8808 - 1.245 = 1.6358$$

$$p = 43.2 \text{ mm.}$$

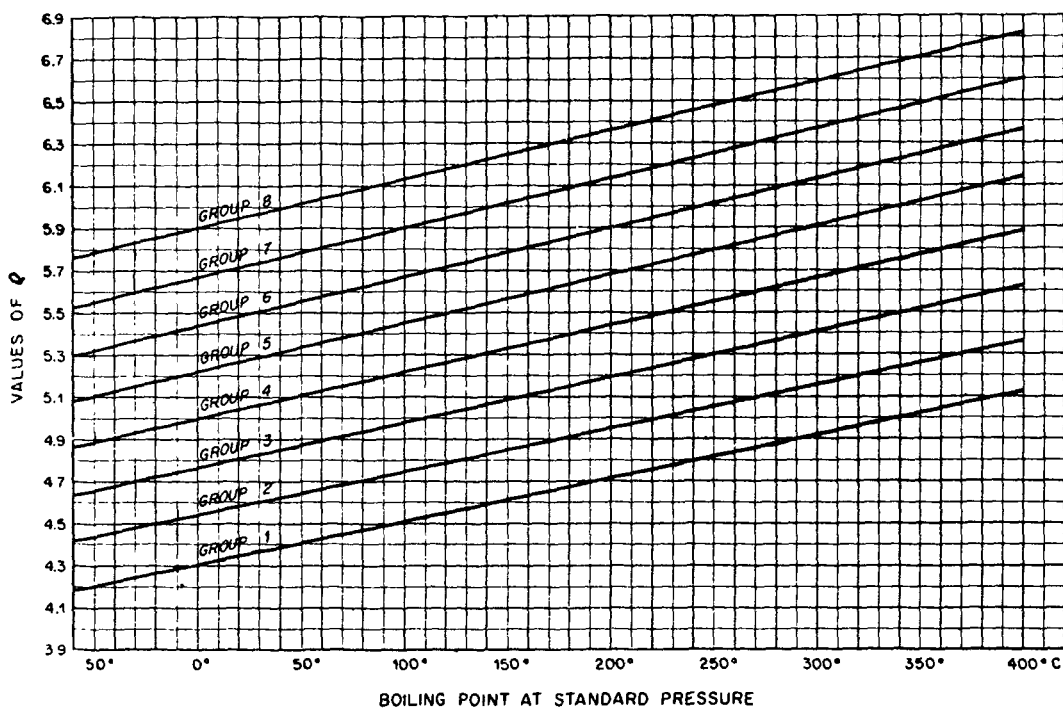
Here no second approximation is necessary, since the correct value of  $\phi$  was taken immediately, the normal boiling point having been known.

Compound	Group	Compound	Group
Acetaldehyde .....	3	Benzyl alcohol .....	5
Acetic acid .....	4	Butylethylene .....	1
Acetic anhydride .....	6	Butyric acid .....	7
Acetone .....	3	Camphor .....	2
Acetophenone .....	4	Carbon monoxide .....	1
Amines .....	3	Carbon oxysulfide .....	2
<i>n</i> -Amyl alcohol .....	8	Carbon suboxide .....	2
Anthracene .....	1	Carbon selenide .....	2
Anthraquinone .....	1	<i>m.p.</i> Chloroanilines .....	3
Benzaldehyde .....	2	Chlorinated derivatives .....	Same group as though Cl was H
Benzoic acid .....	5	<i>o.m.p.</i> Cresols .....	4
Benzonitrile .....	2	Cyanogen .....	4
Benzophenone .....	2		



### CORRECTION OF BOILING POINTS (Continued)

Compound	Group	Compound	Group
Cyanogen chloride.....	3	Methyl benzoate.....	3
Dibenzyl ketone.....	2	Methyl ether.....	3
Dimethyl amine.....	4	Methyl ethyl ether.....	3
Dimethyl oxalate.....	4	Methyl ethyl ketone.....	2
Dimethyl silicane.....	2	Methyl fluoride.....	3
Esters.....	3	Methyl formate.....	4
Ethanol.....	8	Methyl salicylate.....	2
Ethers.....	2	Methyl silicane.....	1
Ethylamine.....	4	$\alpha, \beta$ Naphthols.....	3
Ethylene glycol.....	7	Nitrobenzene.....	3
Ethylene oxide.....	3	Nitromethane.....	3
Formic acid.....	3	o.m.p. Nitrotoluenes.....	2
Glycol diacetate.....	4	o.m.p. Nitrotoluidines.....	2
Halogen derivatives.....	Same group as though halogen were hydrogen.	Phenanthrene.....	1
Heptylic acid.....	7	Phenol.....	5
Hydrocarbons.....	2	Phosgene.....	2
Hydrogen cyanide.....	3	Phthalic anhydride.....	2
Isoamyl alcohol.....	7	Propionic acid.....	5
Isobutyl alcohol.....	8	<i>n</i> -Propyl alcohol.....	8
Isobutyric acid.....	6	Quinoline.....	2
Isocaproic acid.....	7	Sulfides.....	2
Methane.....	1	Tetranitromethane.....	3
Methanol.....	7	Trichloroethylene.....	1
Methyl amine.....	5	Valeric acid.....	7
		Water.....	6



## MOLECULAR ELEVATION OF THE BOILING POINT

(Most values from Hoyt, C.S. and Fink, C.K., Journal of Physical Chemistry, Vol. 41, No. 3., March, 1937.)

Molecular elevation of the boiling point showing the elevation of the boiling point in degrees C due to the addition of one gram molecular weight of the dissolved substance to 1000 grams of any one of the solvents below. The correction in the last column gives the number of degrees to be subtracted for each mm. of difference between the barometric reading and 760 mm.

Solvent	K <sub>B</sub>	Barometric Correction per mm.
Acetic acid.....	3.07	0.0008
Acetone.....	1.71	0.0004
Aniline.....	3.52	0.0009
Benzene.....	2.53	0.0007
Bromobenzene.....	6.26	0.0016
Carbon bisulfide.....	2.34	0.0006
Carbon tetrachloride.....	5.03	0.0013
Chloroform.....	3.63	0.0009
Cyclohexane.....	2.79	0.0007
Ethanol (ethyl alcohol).....	1.22	0.0003
Ethyl acetate.....	2.77	0.0007
Ethyl ether.....	2.02	0.0005
<i>n</i> -Hexane.....	2.75	0.0007
Methanol (methyl alcohol).....	0.83	0.0002
Methyl acetate.....	2.15	0.0005
Nitrobenzene.....	5.24	0.0013
<i>n</i> -Octane.....	4.02	0.0010
Phenol.....	3.56	0.0009
Toluene.....	3.33	0.0008
Water.....	0.512	0.0001

## MOLECULAR DEPRESSION OF THE FREEZING POINT

Showing the depression of the freezing point due to the addition of one gram molecular weight of solute, for various solvents.

Solvent	Depression for one gram molecular weight dissolved in 1000 grams, °C	Solvent	Depression for one gram molecular weight dissolved in 1000 grams, °C
Acetic acid	3.90	Diphenylamine	8.60
Acetophenone	5.65	Diphenyl ether	8.00
Aniline	5.87	Ethylene dibromide	11.80
Anthracene	14.65	Ethyl ether	11.79
Anthraquinone	14.80	Formic acid	2.77-2.80
Benzene	4.90-5.23	Hexachlorobenzene	20.75
Benzoic acid	7.85-8.79	Menthol	12.4
Benzophenone	9.88	Naphthalene	6.90-7.10
<i>d</i> -Bromocamphor	11.87	$\beta$ -Naphthol	11.25
Bromoform	14.25	Nitrobenzene	6.89-7.10
<i>tert</i> -Butyl alcohol	12.80	Phenanthrene	12.0
Camphor	49.80	Phenol	7.20-7.50
Carbazole	12.30	Phenylhydrazine	5.86
Carbon disulfide	3.83	Pyridine	4.97
Carbon tetrachloride	29.8-34.8	Stearic acid	4.50
Chloroform	4.67-4.90	Triphenylmethane	12.45
Cyclohexane	20.0-20.30	Urethane	5.00-5.14
Dicyclohexyl	14.50	Water	1.85-1.87
<i>m</i> -Dinitrobenzene	10.60	<i>p</i> -Xylene	4.30
Diphenyl	8.00-8.35		

## CARBOHYDRATES

These data for carbohydrates were compiled originally for the Biology Data Book by M L Wolfram, G G Maher and R G Pagnucco (1964) Data are reproduced here by permission of the copyright owners of the above publication, the Federation of American Societies for Experimental Biology, Washington, D C pp 351-359

All data are for crystalline substances, unless otherwise specified Selection of substances was restricted to natural carbohydrates found free (or in chemical combination and released on hydrolysis) and to biological oxidation products of the natural carbohydrates The nomenclature conforms with that of the British-American report as published in the *Journal of Organic Chemistry*, 28 281 (1963) Substances have been arranged alphabetically under the name of the parent sugar within groups formulated according to increasing carbon content (excluding carbon in substituents), with synonymous common names in parentheses **Melting Point:** b p = boiling point, d = decomposes, s = sinters **Specific Rotation** was determined in water at concentrations of 1-5 g per 100 ml of solution and at 20°-25°C, unless otherwise specified, other temperatures or wavelengths are shown in brackets *c* = grams solute per 100 ml of solution

## Part I. NATURAL MONOSACCHARIDES: ALDOSES AND KETOSES

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>
(A)	(B)	(C)	(D)
Aldoses			
1 D-Glyceraldehyde	C <sub>3</sub> H <sub>6</sub> O <sub>3</sub>		+13.5 ± 0.5 (syrup)
2 D-Glyceraldehyde, 3-deoxy-3,3-C-bis-(hydroxymethyl)- (Cordycepose)	C <sub>5</sub> H <sub>10</sub> O <sub>4</sub>		-26 (c 0.6, C <sub>2</sub> H <sub>5</sub> OH)
3 D-Glyceraldehyde, 3,3-bis(C-hydroxymethyl)- (Apiose)	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>		+5.6 (c 10) [15°] syrup
4 β-D-Arabinose	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	155	-175 → -103
5 D-Arabinose, 2-O-methyl-	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	Syrup	-102
6 α-L-Arabinose	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	158 amorphous	+55.4 → +105
7 β-L-Arabinose	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	160	+190.6 → +104.5
8 D-L-Arabinose	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	163.5-164.5	None
9 α-L-Lyxose	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	105	+5.8 → +13.5
10 L-Lyxose, 5-deoxy-3-C-formyl- (Streptose)	C <sub>6</sub> H <sub>10</sub> O <sub>5</sub>		
11 L-Lyxose, 3-C-formyl- (Hydroxystreptose)	C <sub>6</sub> H <sub>10</sub> O <sub>6</sub>		
12 Pentose, 4,5-anhydro-5-deoxy-D-erythro-	C <sub>5</sub> H <sub>8</sub> O <sub>3</sub>		
13 Pentose, 2-deoxy-D-erythro-	C <sub>5</sub> H <sub>10</sub> O <sub>4</sub>	96-98	-91 → -58
14 D-Ribose	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	87	-23.1 → -23.7
15 D-Ribose, 2-C-hydroxymethyl- (Hamamelose)	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>		-7.1 [λ578]
16 α-D-Xylose	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	145	+93.6 → +18.8
17 D-Xylose, 5-deoxy-	C <sub>5</sub> H <sub>10</sub> O <sub>4</sub>		+16
18 β-D-Xylose, 2-O-methyl-	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	137-138	-21 → +34
19 α-D-Xylose, 3-O-methyl-	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	95	+45 → +19
20 D-Allose, 6-deoxy-	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	140-143 146-148	+1.6 [18°] (c 0.6) -4.7 → 0
21 D-Allose, 6-deoxy-2,3-di-O-methyl- (Mycnose)	C <sub>8</sub> H <sub>16</sub> O <sub>6</sub>	102-106	-46 → -29
22 Amicetose (a trideoxy hexose)	C <sub>6</sub> H <sub>12</sub> O <sub>3</sub>	Oil, b p 65-70	+28.6 (CHCl <sub>3</sub> )
23 Antiarose	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>		Levo
24 α-D-Galactose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	167	+150.7 → +80.2
25 β-D-Galactose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	143-145	+52.8 → +80.2
26 D-Galactose, 3,6-anhydro-	C <sub>6</sub> H <sub>10</sub> O <sub>5</sub>		+21.3 [10°]
27 α-D-Galactose, 6-deoxy- (D-Fucose, Rhodeose)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	140-145	+127 → +76.3 (c 10)
28 D-Galactose, 6-deoxy-3-O-methyl- (Digitalose)	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>	106 <sup>1</sup> , 119 <sup>2</sup>	+106

**CARBOHYDRATES (Continued)**

**Part I. NATURAL MONOSACCHARIDES: ALDOSES AND KETOSES (Continued)**

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation $[\alpha]_D$
(A)	(B)	(C)	(D)
Aldoses (Con t)			
29 D-Galactose, 6-deoxy-4- <i>O</i> -methyl-	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>	131-132	+82
30 D-Galactose, 6-deoxy-2,3-di- <i>O</i> -methyl-	C <sub>8</sub> H <sub>16</sub> O <sub>5</sub>		+73
31 α-D-Galactose, 3- <i>O</i> -methyl-	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>	144-147	+150.6 → +108.6
32 α-D-Galactose, 6- <i>O</i> -methyl-	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>	122-123	+117 → +77.3
33 L-Galactose	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>		See D-Galactose
34 α-L-Galactose, 3,6-anhydro-	C <sub>6</sub> H <sub>10</sub> O <sub>3</sub>		-39.4 → -25.2
35 α-L-Galactose, 6-deoxy- (L-Fucose)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	145	-124.1 → -76.4
36 L-Galactose, 6-deoxy-2- <i>O</i> -methyl-	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>	149-150	-75 ± 4 (c 0.5)
37 L-Galactose, 6-sulfate	C <sub>6</sub> H <sub>12</sub> O <sub>9</sub> S		-47 (c 0.2) (Na salt)
38 DL-Galactose	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	143-144, 163	None (racemic)
39 α-D-Glucose	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	146, 83 (H <sub>2</sub> O)	+112 → +52.7
40 β-D-Glucose	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	148-150	+18.7 → +52.7
41 D-Glucose, 6-acetate	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub>	135	+48
42 D-Glucose, 2,3-di- <i>O</i> -methyl-	C <sub>8</sub> H <sub>16</sub> O <sub>5</sub>	85-86, 121	+50
43 D-Glucose, 6- <i>O</i> -benzoyl- (Vaccinin)	C <sub>13</sub> H <sub>16</sub> O <sub>7</sub>	Amorphous	+48 (C <sub>2</sub> H <sub>5</sub> OH)
44 α-D-Glucose, 6-deoxy- (Chinovose, Epirhamnose, Glucomethylose, Isorhamnose, Isorhodeose Quinovose)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	139-140	+73.3 → +29.7 (c 8)
45 α-D-Glucose, 6-deoxy-3- <i>O</i> -methyl- (D-Thevetose)	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>	116	+84 → +33
46 D-Glucose, 6-sulfonic acid, 6-deoxy- (6-Sulfoquinovose)	C <sub>6</sub> H <sub>12</sub> O <sub>8</sub> S	173-174	+87 <sup>3</sup>
47 D-Glucose, 3- <i>O</i> -methyl-	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>	162-167	+98 → +59.5
48 α-L-Glucose	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	141-143	-95.5 → -51.4
49 L-Glucose, 6-deoxy-3- <i>O</i> -methyl- (L-Thevetose)	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>	126-129	-36.9 ± 2
50 D-Gulose, 6-deoxy-	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>		
51 Hexose, 2-deoxy-D- <i>arabino</i> - <sup>4</sup>	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	148	+46.6 [18°]
52 Hexose, 2,6-dideoxy-3- <i>O</i> -methyl-D- <i>arabino</i> - (D-Oleandrose)	C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>		-11
53 Hexose, 3,6-dideoxy-D- <i>arabino</i> - (Tyvelose)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>		+24 ± 2
54 Hexose, 2,6-dideoxy-3- <i>O</i> -methyl-L- <i>arabino</i> - (L-Oleandrose)	C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>	62-63	+11.9 ± 2.5
55 Hexose, 3,6-dideoxy-L- <i>arabino</i> - (Ascarylose)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>		-24 ± 2
56 Hexose, 2,6-dideoxy-3- <i>O</i> -methyl-D- <i>lyxo</i> - (Diginose)	C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>	90-92	+56 ± 4
57 Hexose, 2,6-dideoxy-L- <i>lyxo</i> - (L-Fucose, 2-deoxy-)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>	103-106	-61.6
58 Hexose, 2,6-dideoxy-3- <i>O</i> -methyl-L- <i>lyxo</i> -	C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>	78-85	-65
59 Hexose, 2,6-dideoxy-D- <i>ribo</i> - (Digitoxose, D-Altrose, 2,6-dideoxy-)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>	110	+46.4
60 Hexose, 2,6-dideoxy-3- <i>O</i> -methyl-D- <i>ribo</i> - (Cymarose)	C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>	93	+52
61 Hexose, 3,6-dideoxy-D- <i>ribo</i> - (Paratose)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>		+10 ± 2 (c 0.9)
62 Hexose, 4,6-dideoxy-3- <i>O</i> -methyl-D- <i>ribo</i> - (D-Gulose, 4,6-dideoxy-3- <i>O</i> -methyl-, Chalcose)	C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>	96-99	+120 → +76
63 Hexose, 2,6-dideoxy-D- <i>xylo</i> - (Boivinose)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>	96-98	-3.9 → +3.9

**CARBOHYDRATES (Continued)**

**Part I. NATURAL MONOSACCHARIDES: ALDOSES AND KETOSES (Continued)**

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>
(A)	(B)	(C)	(D)
<b>Aldoses (Con't)</b>			
64 Hexose, 2,6-dideoxy-3- <i>O</i> -methyl- <i>D</i> -xylo- (Sarmentose)	C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>	78-79	+12 → +15.8
65 Hexose, 3,6-dideoxy- <i>D</i> -xylo- (Abequose)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>		-3.2 ± 0.6
66 Hexose, 2,6-dideoxy-3- <i>C</i> -methyl- <i>L</i> -xylo- (Mycarose)	C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>	129-129	-31.1
67 Hexose, 2,6-dideoxy-3- <i>C</i> -methyl-3- <i>O</i> -methyl- <i>L</i> -xylo- (Cladinose)	C <sub>8</sub> H <sub>16</sub> O <sub>4</sub>	oil, b p 120-132 (0.25 mm)	-23.1
68 Hexose, 3,6-dideoxy- <i>L</i> -xylo- (Colitose)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>		+4 (H <sub>2</sub> O), -51 ± 2 (CH <sub>3</sub> OH)
69 <i>D</i> -Idose <sup>5</sup>	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>		
70 <i>L</i> -Idose, 1,6-anhydro-	C <sub>6</sub> H <sub>10</sub> O <sub>5</sub>		
71 α- <i>D</i> -Mannose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	133	+29.3 → +14.5
72 β- <i>D</i> -Mannose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	132	-16.3 → +14.5
73 <i>D</i> -Mannose, 6-deoxy- ( <i>D</i> -Rhamnose)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	86-90	-7.0
74 α- <i>L</i> -Mannose, 6-deoxy-monohydrate ( <i>L</i> -Rhamnose)	C <sub>6</sub> H <sub>14</sub> O <sub>6</sub>	93-94	-8.6 → +8.2
75 β- <i>L</i> -Mannose, 6-deoxy-	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	123-125	+38.4 → +8.9
76 <i>L</i> -Mannose, 6-deoxy-2- <i>O</i> -methyl-	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>		
77 <i>L</i> -Mannose, 6-deoxy-3- <i>O</i> -methyl- ( <i>L</i> -Acofrinose)	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>	114-115	+30 [18°]
78 <i>L</i> -Mannose, 6-deoxy-2,4-di- <i>O</i> -methyl-	C <sub>8</sub> H <sub>16</sub> O <sub>5</sub>	82	-19 [16°]
79 <i>L</i> -Mannose, 6-deoxy-5- <i>C</i> -methyl-4- <i>O</i> -methyl- ( <i>Noviose</i> )	C <sub>8</sub> H <sub>16</sub> O <sub>5</sub>	128-130	+19.9 (50% C <sub>2</sub> H <sub>5</sub> OH)
80 Rhodinose (a 2,3,6-trideoxyhexose)	C <sub>6</sub> H <sub>12</sub> O <sub>3</sub>		-11 ± 1.6
81 <i>D</i> -Talose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	128-132	+16.9
82 <i>D</i> -Talose, 6-deoxy- ( <i>D</i> -Talomethyllose)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	129-131	+20.6
83 <i>L</i> -Talose, 6-deoxy- ( <i>L</i> -Talomethyllose)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	116-118	-19.5 ± 2 [18°]
84 <i>L</i> -Talose, 6-deoxy-2- <i>O</i> -methyl- ( <i>L</i> -Acovenose)	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>		-19.4
85 Heptose, <i>D</i> -glycero- <i>D</i> -galactose	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub>	139-140	+47 → +64 (c 0.5)
86 Heptose, <i>D</i> -glycero- <i>D</i> -mannose	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub>		
87 Heptose, <i>D</i> -glycero- <i>L</i> -mannose	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub>		
<b>Ketoses</b>			
88 Dihydroxyacetone	C <sub>3</sub> H <sub>6</sub> O <sub>3</sub>	80 (dimer)	None
89 Tetrulose, <i>L</i> -glycero- <sup>8</sup> ( <i>L</i> -Erythrulose, Ketoerythritol, <i>L</i> -Threulose)	C <sub>4</sub> H <sub>8</sub> O <sub>4</sub>	Syrup	+12
90 Pentulose, <i>D</i> -erythro- ( <i>Adonose</i> , <i>D</i> -Ribulose)	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	Syrup	+16.6 [27°]
91 Pentulose, <i>L</i> -erythro- ( <i>L</i> -Ribulose)	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>		-16.6
92 Pentulose, <i>D</i> -threo- ( <i>D</i> -Xylulose)	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>		-33
93 Pentulose, 5-deoxy- <i>D</i> -threo-	C <sub>5</sub> H <sub>10</sub> O <sub>4</sub>		-5 ± 1 (CH <sub>3</sub> OH)
94 Pentulose, <i>L</i> -threo- ( <i>L</i> -Xylulose, <i>L</i> -Lyxulose, Xyloketose)	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	Syrup	+33.1
95 Hexulose, β- <i>D</i> -arabino- (β- <i>D</i> -Fructose, Levulose)	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	102-104 <sup>7</sup>	-133.5 → -92
96 Hexulose, 6-deoxy- <i>D</i> -arabino- ( <i>D</i> -Rhamnulose)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>		-13 ± 2
97 Hexulose, <i>D</i> -lyxo- ( <i>D</i> -Tagatose)	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	131-132	+2.7 → -4, -5
98 5-Hexulose, <i>D</i> -lyxo	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	158	-86.6
99 Hexulose, 6-deoxy- <i>L</i> -lyxo- ( <i>L</i> -Fuculose)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>		

**CARBOHYDRATES (Continued)**

**Part I. NATURAL MONOSACCHARIDES: ALDOSES AND KETOSES (Continued)**

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation $[\alpha]_D$
(A)	(B)	(C)	(D)
<b>Ketoses (Con't)</b>			
100 Hexulose, <i>D-ribo-</i> ( <i>D- Psicose</i> )	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	Amorphous	+4.7
101 Hexulose, <i>L-xyl-</i> ( <i>L-Sorbose</i> )	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	159-161	-43.1
102 Hexulose, 6-deoxy- <i>L-xyl-</i>	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	88	-25 ± 2 (c 0.7)
103 Heptulose, <i>D-altr-</i> ( <i>Sedoheptulose</i> , <i>Sedoheptose</i> )	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub>	Amorphous	+2.5 (c 10)
104 Heptulose-hemihydrate, <i>L-galacto-</i> ( <i>Perseulose</i> )	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub> . $\frac{1}{2}$ H <sub>2</sub> O	110-115	-90 → -80
105 Heptulose, <i>L-gulo-</i>	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub>		-28
106 Heptulose, <i>D-ido-</i>	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub>	172	-34 ± 8 (c 0.3)
107 Heptulose, <i>D-manno-</i> ( <i>Mannoketo-</i> <i>heptose</i> , <i>D-Mannotagatoheptose</i> )	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub>	152	+29.4
108 Heptulose, <i>D-talo-</i>	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub>		
109 Octulose, <i>D-glycero-L-galacto-</i>	C <sub>8</sub> H <sub>16</sub> O <sub>8</sub>		-57, -43.4 → -13.4
110 Octulose, <i>D-glycero-D-manno-</i>	C <sub>8</sub> H <sub>16</sub> O <sub>8</sub>		+20 (CH <sub>3</sub> OH)

<sup>1</sup> Original melting point. <sup>2</sup> Melting point after four-months' storage. <sup>3</sup> As a methyl glycoside cyclohexylamine salt. <sup>4</sup> Included because of speculations concerning it in biological processes. <sup>5</sup> Either *D-ido-* or *L-altr-* is in the polysaccharide varianose. <sup>6</sup> Early literature refers to this as *D-erythro-*. <sup>7</sup> The  $\frac{1}{2}$ H<sub>2</sub>O and ·2H<sub>2</sub>O forms also exist.

**Part II. NATURAL MONOSACCHARIDES: AMINO SUGARS**

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation $[\alpha]_D$
(A)	(B)	(C)	(D)
<b>Aldosamines</b>			
1 <i>D-Ribose</i> , 3-amino-3-deoxy-	C <sub>5</sub> H <sub>11</sub> NO <sub>4</sub>	158-158.5 d.	-24.6 (hydrochloride)
2 <i>D-Galactose</i> , 2-amino-2-deoxy- ( <i>Galactosamine</i> ; <i>Chondrosamine</i> )	C <sub>6</sub> H <sub>13</sub> NO <sub>5</sub>	185	+121 → +80 (hydrochloride)
3 $\alpha$ - <i>L-Galactose</i> , 2-amino-2,6-dideoxy- ( <i>L-Fucosamine</i> )	C <sub>6</sub> H <sub>13</sub> NO <sub>4</sub>	192-193 d.	-119 → -92 [27°] (hydrochloride)
4 $\alpha$ - <i>D-Glucose</i> , 2-amino-2-deoxy- ( <i>Glucosamine</i> ; <i>Chitosamine</i> )	C <sub>6</sub> H <sub>13</sub> NO <sub>5</sub>	88	+100 → +47.5
5 $\beta$ - <i>D-Glucose</i> , 2-amino-2-deoxy-	C <sub>6</sub> H <sub>13</sub> NO <sub>5</sub>	110-111	+28 → +47.5
6 <i>D-Glucose</i> , 3-amino-3-deoxy- ( <i>Kanosamine</i> )	C <sub>6</sub> H <sub>13</sub> NO <sub>5</sub>	128 d.	+19 [14°]
7 <i>D-Glucose</i> , 6-amino-6-deoxy-	C <sub>6</sub> H <sub>13</sub> NO <sub>5</sub>	161-162 d.	+23 → +50.1 (hydrochloride)
8 <i>D-Glucose</i> , 2,6-diamino-2,6-dideoxy- ( <i>Neosamine C</i> )	C <sub>6</sub> H <sub>14</sub> N <sub>2</sub> O <sub>4</sub>	> 230	+61.5 (dihydrochloride)
9 <i>D-Glucose</i> , 3,6-dideoxy-3-dimethylamino- ( <i>Mycaminose</i> )	C <sub>8</sub> H <sub>17</sub> NO <sub>4</sub>	115-116	+31 (hydrochloride)
10 <i>D-Glucose</i> , 4,6-dideoxy-4-dimethylamino-	C <sub>8</sub> H <sub>17</sub> NO <sub>4</sub>	192-193	+45.5 (hydrochloride)
11 <i>L-Glucose</i> , 2-deoxy-2-methylamino-	C <sub>7</sub> H <sub>15</sub> NO <sub>5</sub>	130-132	-64
12 <i>D-Gulose</i> , 2-amino-1,6-anhydro-2-deoxy-	C <sub>6</sub> H <sub>11</sub> NO <sub>4</sub>	250-260 d.	+41 ± 2 (hydrochloride)
13 <i>D-Gulose</i> , 2-amino-2-deoxy-	C <sub>6</sub> H <sub>11</sub> NO <sub>5</sub>	152-162 d.	+5.6 → -18.7 (hydrochloride)

**CARBOHYDRATES (Continued)**  
**Part II. NATURAL MONOSACCHARIDES: AMINO SUGARS (Continued)**

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation $[\alpha]_D$
(A)	(B)	(C)	(D)
<b>Aldosamines (Con't)</b>			
14 Hexose, 3,4,6-trideoxy-3-dimethyl-amino-D-xylo- (Desosamine, Picrocine)	$C_8H_{17}NO_3$	189-191 d	+49.5 (c 10) (hydrochloride)
15 Hexose, a 4-acetamido-2-amino-2,4,6-trideoxy-	$C_8H_{16}N_2O_4$	216-219	+115 → +94 [26°] (c 0.05)
16 Hexose, an amino-deoxy-3-O-carboxyethyl-	$C_9H_{17}NO_7$		
17 Hexose, a 2,6-diamino-2,6-dideoxy- (Neosamine B, Paramose)	$C_6H_{14}N_2O_4$	135-150 d	+17.5 (c 0.9) (hydrochloride)
18 Hexose, a 3-dimethylamino-2,3,6-trideoxy- (Rhodosamine)	$C_8H_{17}NO_3$		
19 D-Mannose, 2-amino-2-deoxy- (Mannosamine)	$C_6H_{13}NO_5$	142 d	-4.3 (c 9) (hydrochloride)
20 D-Mannose, 3-amino-3,6-dideoxy- (Mycosamine)	$C_6H_{13}NO_4$	162	-11.5 (hydrochloride)
21 D-Talose, 2-amino-2-deoxy- (Talosamine)	$C_6H_{13}NO_5$	151-153	+3.4 → -5.7 (c 0.9) (hydrochloride)
22 L-Talose, 2-amino-2,6-dideoxy- (Pneumosamine)	$C_6H_{13}NO_4$	162-163	+6.9 → +10.4 (hydrochloride)
<b>Ketosamines</b>			
23 Pentulose, 1-(o-carboxyanilino)-1-deoxy-D-erythro-	$C_{12}H_{14}NO_6$		
24 Hexulose, 1-(o-carboxyanilino)-1-deoxy-D-arabino-	$C_{13}H_{16}NO_7$		
25 Hexulose, 5-amino-5-deoxy-L-xylo-	$C_6H_{13}NO_5$	174-176	-62
26 Hexulose, 6-deoxy-6-(N-methylacetamido)-L-xylo-	$C_9H_{17}NO_6$		-

**Part III. NATURAL ALDITOLS AND INOSITOLS (with Inososes and Inosamines)**

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation $[\alpha]_D$
(A)	(B)	(C)	(D)
<b>Alditols</b>			
1 Glycerol	$C_3H_8O_3$	20	None
2 Glycerol, 1-deoxy- (1,2-Propane-diol) <sup>1</sup>	$C_3H_8O_2$	Oil, b p 188-189	None (racemic)
3 Erythritol	$C_4H_{10}O_4$	118-120	None (meso)
4 Erythritol, 1,4-dideoxy- (2,3-Butylene-glycol)	$C_4H_{10}O_2$	25, 34	None (meso)
5 D-Threitol, 1,4-dideoxy-	$C_4H_{10}O_2$	19	-13.0
6 L-Threitol, 1,4-dideoxy-	$C_4H_{10}O_2$		+10.2
7 DL-Threitol, 1,4-dideoxy-	$C_4H_{10}O_2$	7.6	None (racemic)
8 D-Arabinitol	$C_5H_{12}O_5$	103	+7.82 (c 8, borax solution)
9 L-Arabinitol	$C_5H_{12}O_5$	101-102	-32 (c 0.4, 5% molybdate)
10 Ribitol (Adomitol)	$C_6H_{12}O_5$	102	None (meso)
11 Galactitol (Dulcitol)	$C_6H_{14}O_6$	186-188	None (meso)

**CARBOHYDRATES (Continued)**  
**Part III. NATURAL ALDITOLS AND INOSITOLS**  
**(with Inososes and Inosamines) (Continued)**

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>
(A)	(B)	(C)	(D)
<b>Alditols (Con't)</b>			
12 D-Glucitol (Sorbitol)	C <sub>6</sub> H <sub>14</sub> O <sub>6</sub>	112	-1.8 [15°]
13 D-Glucitol, 1,5-anhydro- (Polygalitol)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	140-141	+42.4
14 L-Iditol	C <sub>6</sub> H <sub>14</sub> O <sub>6</sub>	73.5	-3.5 (c 10)
15 D-Mannitol	C <sub>6</sub> H <sub>14</sub> O <sub>6</sub>	166	-0.21
16 D-Mannitol, 1,5-anhydro- (Styracitol)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	157	-49.9
17 Heptitol, D-glycero-D-galacto- (Heptitol, L-glycero-D-manno-; Perseitol)	C <sub>7</sub> H <sub>16</sub> O <sub>7</sub>	183-185, 188	-1.1
18 Heptitol, D-glycero-D-gluco- (Heptitol, L-glycero-D-talo-; β-Sedoheptitol)	C <sub>7</sub> H <sub>16</sub> O <sub>7</sub>	131-132	+46 (5% NH <sub>4</sub> molybdate)
19 Heptitol, D-glycero-D-manno- (Heptitol, D-glycero-D-talo-; Volemitol)	C <sub>7</sub> H <sub>16</sub> O <sub>7</sub>	153	+2.65
20 Octitol, D-erythro-D-galacto-	C <sub>8</sub> H <sub>18</sub> O <sub>8</sub> . H <sub>2</sub> O	169-170	-11 (5% NH <sub>4</sub> molybdate)
<b>Inositols</b>			
21 Betitol (a dideoxy inositol)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>	224	.
22 Bioinosose ( <i>scyllo</i> -Inosose; <i>myo</i> -Inosose-2, a deoxy keto inositol)	C <sub>6</sub> H <sub>10</sub> O <sub>6</sub>	198-200	None (meso)
23 <i>h</i> -Bornesitol (a <i>myo</i> -inositol monomethyl ether)	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	200	+31.6
24 <i>l</i> -Bornesitol (a <i>myo</i> -inositol monomethyl ether)	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	205-206	-32.1
25 Conduritol (a 2,3-dehydro-2,3-dideoxyinositol)	C <sub>6</sub> H <sub>10</sub> O <sub>4</sub>	142-143	None (meso)
26 Cordycepic acid (a tetrahydroxycyclohexanecarboxylic acid) <sup>2</sup>	C <sub>7</sub> H <sub>12</sub> O <sub>6</sub>		.
27 Dambonitol (a <i>myo</i> -inositol dimethyl ether)	C <sub>8</sub> H <sub>16</sub> O <sub>6</sub>	206	None (meso)
28 DL-Inositol	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	253	None (racemic)
29 <i>d</i> -Inositol	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>		+60
30 <i>l</i> -Inositol	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	240	-65
31 Laminitol (a <i>C</i> -methyl <i>myo</i> -inositol)	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	266-269	-3
32 Liriodendritol (a <i>myo</i> -inositol dimethyl ether)	C <sub>8</sub> H <sub>16</sub> O <sub>6</sub>	224	-25
33 <i>muco</i> -Inositol monomethyl ether	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	322-325	.
34 <i>myo</i> -Inositol ( <i>meso</i> -Inositol)	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	217-218	None (meso)
35 <i>d</i> - <i>myo</i> -Inosose-1 (a deoxy keto inositol)	C <sub>6</sub> H <sub>10</sub> O <sub>6</sub>	138-139	+19.6
36 Mytilitol (a <i>C</i> -methyl <i>scyllo</i> -inositol)	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	259	None (meso)
37 <i>neo</i> -Inosamine-2 (a deoxy amino inositol)	C <sub>6</sub> H <sub>13</sub> O <sub>5</sub> N	239-241 d.	None (meso)
38 <i>d</i> -Ononitol (a <i>myo</i> -inositol monomethyl ether)	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	172	+6.6
39 <i>h</i> -Pinitol (a <i>dextro</i> -inositol monomethyl ether)	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	186	+65.5
40 <i>l</i> -Pinitol (a <i>levo</i> -inositol monomethyl ether)	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	186	-65
41 <i>l</i> -Quebrachitol (a <i>levo</i> -inositol monomethyl ether)	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	190-191	-80.2 [28°]
42 <i>d</i> -Quercitol (a deoxy <i>dextro</i> -inositol)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	235	+24.2
43 <i>d</i> -Quinic acid (a trideoxy carboxy <i>dextro</i> -inositol)	C <sub>7</sub> H <sub>12</sub> O <sub>6</sub>	164	+44 (c 10)



**CARBOHYDRATES (Continued)**  
**Part III. NATURAL ALDITOLS AND INOSITOLS**  
**(with Inososes and Inosamines) (Continued)**

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>
(A)	(B)	(C)	(D)
Inositols (Con't)			
44 <i>L</i> -Quinic acid (a trideoxy carboxy <i>levo</i> -inositol)	C <sub>7</sub> H <sub>12</sub> O <sub>8</sub>	162	-42.1
45 Quinic acid, 5-dehydro-	C <sub>7</sub> H <sub>10</sub> O <sub>8</sub>	140-142 (138 s.)	-82.4 [28°]
46 Scyllitol ( <i>scyllo</i> -Inositol; Cocositol)	C <sub>6</sub> H <sub>12</sub> O <sub>8</sub>	352-353	None (meso)
47 Sequoyitol (a <i>myo</i> -inositol monomethyl ether)	C <sub>7</sub> H <sub>14</sub> O <sub>8</sub>	234-235	None (meso)
48 Shikimic acid (a 3,4-anhydro-quinic acid)	C <sub>7</sub> H <sub>10</sub> O <sub>8</sub>	183-184	-200 [16°]
49 Shikimic acid, 5-dehydro-	C <sub>7</sub> H <sub>8</sub> O <sub>8</sub>	150-152	-57.5 [28°] (EtOH)
50 Streptamine (2,4-diaminodideoxy-scyllitol)	C <sub>8</sub> H <sub>14</sub> O <sub>4</sub> N <sub>2</sub>	88, 210-250 d.	None (meso)
51 Streptamine, 2-deoxy-	C <sub>8</sub> H <sub>14</sub> O <sub>3</sub> N <sub>2</sub>	.....	None (meso)
52 Streptadine (1,3-Dideoxy-1,3-diguani-dino-scyllitol)	C <sub>8</sub> H <sub>18</sub> N <sub>6</sub> O <sub>4</sub>	.....	None (meso)
53 Viburnitol (a deoxy <i>levo</i> -inositol) <sup>3</sup>	C <sub>6</sub> H <sub>12</sub> O <sub>8</sub>	174	-73.9

<sup>1</sup> The 1-phosphate ester of this diol is said to occur in brain tissue and sea-urchin eggs. <sup>2</sup> Strong evidence that cordycepic acid is really *D*-mannitol. <sup>3</sup> Not an enantiomorph of *d*-quercitol; other isomeric relationship is involved.

**Part IV. NATURAL ALDONIC, URONIC, AND ALDARIC ACIDS**

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>
(A)	(B)	(C)	(D)
Aldonic Acids			
1 <i>D</i> -Glyceric acid	C <sub>3</sub> H <sub>6</sub> O <sub>4</sub>	Gum	Dextro
2 <i>L</i> -Glyceric acid	C <sub>3</sub> H <sub>6</sub> O <sub>4</sub>	Gum	Levo
3 <i>D</i> -Arabinonic acid	C <sub>5</sub> H <sub>10</sub> O <sub>6</sub>	114-116	+10.5 (c 6)
4 <i>L</i> -Arabinonic acid	C <sub>5</sub> H <sub>10</sub> O <sub>6</sub>	118-119	-9.6 → -41.7 <sup>1</sup>
5 <i>L</i> -Arabinonic-1,4-lactone	C <sub>5</sub> H <sub>8</sub> O <sub>5</sub>	97-99	-72
6 <i>D</i> -Ribonic acid	C <sub>5</sub> H <sub>10</sub> O <sub>6</sub>	112-113	-17.0
7 <i>D</i> -Xylonic acid	C <sub>5</sub> H <sub>10</sub> O <sub>6</sub>	.....	-2.9 → +20.1 <sup>1</sup>
8 <i>L</i> -Xylonic acid	C <sub>5</sub> H <sub>10</sub> O <sub>6</sub>	.....	-91.8 <sup>1</sup>
9 <i>D</i> -Altronic acid	C <sub>6</sub> H <sub>12</sub> O <sub>7</sub>	.....	+11.5 → +24.8 <sup>1</sup> (Ca salt, <i>N</i> HCl)
10 <i>D</i> -Galactonic acid	C <sub>6</sub> H <sub>12</sub> O <sub>7</sub>	122	-11.2 → +57.6 <sup>1</sup>
11 <i>D</i> -Gluconic acid	C <sub>6</sub> H <sub>12</sub> O <sub>7</sub>	130-132 (110-112 s.)	-6.7 → +11.9 <sup>1</sup>
12 <i>L</i> -Gulonic acid	C <sub>6</sub> H <sub>12</sub> O <sub>7</sub>	Exists only in soln.	[ca. 0°]
13 Hexsonic acid, 2-deoxy- <i>D</i> -arabino-	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	93-95	+68 (lactone)
14 2-Hexulosonic acid, <i>D</i> -arabino-	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>	.....	-81.7 (Na salt)
15 2-Hexulosonic acid, 3-deoxy- <i>D</i> -erythro-	C <sub>6</sub> H <sub>10</sub> O <sub>6</sub>	.....	-29.2 (c 6, Ca salt)
16 2-Hexulosonic acid, <i>D</i> -lyxo-	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>	169	-5
17 5-Hexulosonic acid, <i>D</i> -arabino-	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>	108-109	.....
18 5-Hexulosonic acid, <i>D</i> -xylo-	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>	.....	-14.5
19 <i>D</i> -Mannonic acid	C <sub>6</sub> H <sub>12</sub> O <sub>7</sub>	.....	-15.6
20 <i>D</i> -Gluconic acid, <i>O</i> -β- <i>D</i> -galactopyranosyl- (1 → 4)- (Lactobionic acid)	C <sub>12</sub> H <sub>22</sub> O <sub>12</sub>	.....	+25.1 (Ca salt)

**CARBOHYDRATES (Continued)**  
**Part IV. NATURAL ALDONIC, URONIC, AND ALDARIC ACIDS (Continued)**

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>
(A)	(B)	(C)	(D)
<b>Uronic Acids</b>			
21 L-Lyxuronic acid	C <sub>5</sub> H <sub>8</sub> O <sub>6</sub>		
22 β-D-Galacturonic acid	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>	160	+27 → +55.6
23 α-D-Galacturonic acid·monohydrate	C <sub>6</sub> H <sub>12</sub> O <sub>8</sub>	159-160 (110-115 s)	+97.9 → +50.9
24 D-Galacturonic acid, 2-amino-2-deoxy-	C <sub>6</sub> H <sub>11</sub> O <sub>6</sub> N	160 d.	+84.5 (pH 2 HCl)
25 β-D-Glucuronic acid	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>	156	+11.7 → +36.3
26 D-Glucuronic acid, 2-amino-2-deoxy-	C <sub>6</sub> H <sub>11</sub> O <sub>6</sub> N	120-172 d.	+55
27 D-Glucuronic acid, 3-O-methyl-	C <sub>7</sub> H <sub>12</sub> O <sub>7</sub>	Syrup	+6
28 L-Guluronic acid	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>		
29 L-Iduronic acid	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>		+30
30 β-D-Mannuronic acid	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>	165-167	-47.9 → -23.9
31 α-D-Mannuronic acid·monohydrate	C <sub>6</sub> H <sub>12</sub> O <sub>8</sub>	110 s, 120-130 d.	+16 → -6.1 (c 6.8)
<b>Aldaric Acids</b>			
32 D-Tartaric acid	C <sub>4</sub> H <sub>6</sub> O <sub>6</sub>	170	-15
33 L-Tartaric acid	C <sub>4</sub> H <sub>6</sub> O <sub>6</sub>	170	+15 [15°]
34 L-Malic acid	C <sub>4</sub> H <sub>6</sub> O <sub>5</sub>	100	-2.3 (c 8.4)

<sup>1</sup> Equilibrates with the lactone.

## FATS AND OILS

These data for fats and oils were compiled originally for the Biology Data Book by H. J. Harwood, and R. P. Geyer, 1964. Data are reproduced here by permission of the copyright owners of the above publication, the Federation of American Societies for Experimental Biology, Washington, D C. pp. 380-382. Values are typical rather than average, and frequently were derived from specific analyses for particular samples (especially the constituent fatty acids). Extreme variations may occur, depending on a number

	Fat or Oil	Source	Constants				
			Melting (or Solidi- fication) Point, °C	Specific Gravity (or Density)	Refrac- tive Index (or $n_D^{40}$ )	Iodine Value	Saponi- fication Value
	(A)	(B)	(C)	(D)	(E)	(F)	(G)
1	Land Animals Butterfat	<i>Bos taurus</i>	32 2	0 911 <sup>10°/15°</sup>	1 4548	36 1	227
2	Depot fat	<i>Homo sapiens</i>	(15)	0 918 <sup>15°</sup>	1 4602	67 6	196 2
3	Lard oil	<i>Sus scrofa</i>	(30 5)	0 919 <sup>15°</sup>	1 4615	58 6	194 6
4	Neat's-foot oil	<i>B. taurus</i>		0 910 <sup>25°</sup>	1 464 <sup>25°</sup>	69-76	190-199
5	Tallow, beef	<i>B. taurus</i>				49 5	197
6	Tallow, mutton	<i>Ovis aries</i>	(42 0)	0 945 <sup>15°</sup>	1 4565	40	194
7	Marine Animals Cod-liver oil	<i>Gadus morhua</i>		0 925 <sup>25°</sup>	1 481 <sup>25°</sup>	165	186
8	Herring oil	<i>Clupea harengus</i>		0 900 <sup>60°</sup>	1 4610 <sup>60°</sup>	140	192
9	Menhaden oil	<i>Brevoortia tyrannus</i>		0 903 <sup>60°</sup>	1 4645 <sup>60°</sup>	170	191
10	Sardine oil	<i>Sardinops caerulea</i>		0 905 <sup>60°</sup>	1 4660 <sup>60°</sup>	185	191
11	Sperm oil, body	<i>Physeter macrocephalus</i>				76-88	122-130
12	Sperm oil, head	<i>P. macrocephalus</i>				70	140-144
13	Whale oil	<i>Balaena mysticetus</i>		0 892 <sup>60°</sup>	1 460 <sup>60°</sup>	120	195
14	Plants Babassu oil	<i>Attalea funifera</i>	22-26	(0 893 <sup>60°</sup> )	1 443 <sup>60°</sup>	15 5	247
15	Castor oil	<i>Ricinus communis</i>	(-18 0)	0 961 <sup>15°</sup>	1 4770	85 5	180 3
16	Cocoa butter	<i>Theobroma cacao</i>	34 1	0 964 <sup>15°</sup>	1 4568	36 5	193 8
17	Coconut oil	<i>Cocos nucifera</i>	25 1	0 924 <sup>15°</sup>	1 4493	10 4	268
18	Corn oil	<i>Zea mays</i>	(-20 0)	0 922 <sup>15°</sup>	1 4734	122 6	192 0
19	Cotton seed oil	<i>Gossypium hirsutum</i>	(-1 0)	0 917 <sup>25°</sup>	1 4735	105 7	194 3
20	Linseed oil	<i>Linum usitatissimum</i>	(-24 0)	0 938 <sup>15°</sup>	1 4782 <sup>25°</sup>	178 7	190 3
21	Mustard oil	<i>Brassica hirta</i>		0 9145 <sup>15°</sup>	1 475	102	174
22	Neem oil	<i>Melia azadirachta</i>	-3	0 917 <sup>15°</sup>	1 4615	71	194 5
23	Niger-seed oil	<i>Guizotia abyssinica</i>		0 925 <sup>15°</sup>	1 471	128 5	190
24	Oiticica oil	<i>Licania rigida</i>		0 974 <sup>25°</sup>		140-180	
25	Olive oil	<i>Olea europaea sativa</i>	(-6 0)	0 918 <sup>15°</sup>	1 4679	81 1	189 7
26	Palm oil	<i>Elaeis guineensis</i>	35 0	0 915 <sup>15°</sup>	1 4578	54 2	199 1
27	Palm-kernel oil	<i>E. guineensis</i>	24 1	0 923 <sup>15°</sup>	1 4569	37 0	219 9
28	Peanut oil	<i>Arachis hypogaea</i>	(3 0)	0 914 <sup>15°</sup>	1 4691	93 4	192 1
29	Perilla oil	<i>Perilla frutescens</i>		(0 935 <sup>15°</sup> )	1 481 <sup>25°</sup>	195	192
30	Poppy-seed oil	<i>Papaver somniferum</i>	(-15)	0 925 <sup>15°</sup>	1 4685	135	194
31	Rapeseed oil	<i>Brassica campestris</i>	(-10)	0 915 <sup>15°</sup>	1 4706	98 6	174 7
32	Safflower oil	<i>Carthamus tinctorius</i>		(0 900 <sup>60°</sup> )	1 462 <sup>60°</sup>	145	192
33	Sesame oil	<i>Sesamum indicum</i>	(-6 0)	0 919 <sup>25°</sup>	1 4646	106 6	187 9
34	Soybean oil	<i>Glycine soja</i>	(-16 0)	0 927 <sup>15°</sup>	1 4729	130 0	190 6
35	Sunflower-seed oil	<i>Helianthus annuus</i>	(-17 0)	0 923 <sup>15°</sup>	1 4694	125 5	188 7
36	Tung oil	<i>Aleurites fordii</i>	(-2 5)	0 934 <sup>15°</sup>	1 5174 <sup>25°</sup>	168 2	193 1
37	Wheat-germ oil	<i>Triticum aestivum</i>				125	

<sup>1</sup> Caproic. <sup>2</sup> Capryli. <sup>3</sup> Capric. <sup>4</sup> Butyric. <sup>5</sup> Decenoic. <sup>6</sup> C<sub>12</sub> monoethenoic. <sup>7</sup> C<sub>14</sub> monoethenoic. <sup>8</sup> Gado-leic plus crucic. <sup>9</sup> C<sub>12</sub> n-pentadecanoic. <sup>10</sup> C<sub>17</sub> margaric. <sup>11</sup> 12-Methyl tetradecanoic. <sup>12</sup> C<sub>20</sub> polyethenoic.

FATS AND OILS

of variables such as source, treatment, and age of a fat or oil **Specific Gravity** (column D) was calculated at the specified temperature (degrees centigrade) and referred to water at the same temperature, unless otherwise specified **Density**, shown in parentheses (column D), was measured at the specified temperature (degrees centigrade) **Refractive Index** (column E) was measured at 50°C, unless otherwise specified

Constituent Fatty Acids, g/100 g total fatty acids

Saturated						Unsaturated				
Lauric	Myristic	Palmitic	Stearic	Arachidic	Other	Palmitoleic	Oleic	Linoleic	Linolenic	Other
(H)	(I)	(J)	(K)	(L)	(M)	(N)	(O)	(P)	(Q)	(R)
1	2 5	11 1	29 0	9 2	2 4	2 0 <sup>1</sup> , 0 5 <sup>2</sup> , 2 3 <sup>3</sup>	4 6	26 7	3 6	3 6 <sup>4</sup> , 0 1 <sup>5</sup> , 0 1 <sup>6</sup> , 0 9 <sup>7</sup> , 1 4 <sup>8</sup> , 1 0 <sup>9</sup> , 1 0 <sup>10</sup> , 0 4 <sup>11</sup>
2		2 7	24 0	8 4			5	46 9	10 2	2 5 <sup>8</sup>
3		1 3	28 3	11 9			2 7	47 5	6	0 2 <sup>7</sup> , 2 1 <sup>8</sup>
4			17-18	2 3				74 76		
5		6 3	27 4	14 1				49 6	2 5	
6		4 6	24 6	30 5				36 0	4 3	
7		5 8	8 4	0 6			20 0	←29 1→		25 4 <sup>12</sup> , 9 6 <sup>13</sup>
8		7 3	13 0	Trace			4 9		20 7	30 1 <sup>12</sup> , 23 2 <sup>13</sup>
9		5 9	16 3	0 6	0 6		15 5		29 6	19 0 <sup>12</sup> , 11 7 <sup>13</sup> , 0 8 <sup>14</sup>
10		5 1	14 6	3 2			11 8	←17 8→		18 1 <sup>12</sup> , 14 0 <sup>13</sup> , trace <sup>7</sup> , 15 4 <sup>15</sup>
11	1	5	6 5				26 5	37	19	1 <sup>13</sup> , 4 <sup>7</sup> , 19 <sup>16</sup>
12	16	14	8	2	3 5 <sup>3</sup>		15	17	6 5	4 <sup>6</sup> , 14 <sup>7</sup> , 6 5 <sup>16</sup>
13	0 2	9 3	15 6	2 8			14 4	35 2		13 6 <sup>12</sup> , 5 9 <sup>13</sup> , 2 5 <sup>7</sup> , 0 2 <sup>17</sup>
14	44 1	15 4	8 5	2 7	0 2	0 2 <sup>1</sup> , 4 8 <sup>2</sup> , 6 6 <sup>3</sup>		16 1	1 4	
15	←2 4→							7 4	3 1	87 <sup>18</sup>
16			24 4	35 4				38 1	2 1	
17	45 4	18 0	10 5	2 3	0 4 <sup>19</sup>	0 8 <sup>1</sup> , 5 4 <sup>2</sup> , 8 4 <sup>3</sup>	0 4	7 5	Trace	
18		1 4	10 2	3 0			1 5	49 6	34 3	
19		1 4	23 4	1 1	1 3		2 0	22 9	47 8	
20			6 3	2 5	0 5			19 0	24 1	47 4
21		1 3 <sup>20</sup>						27 2 <sup>20</sup>	16 6 <sup>20</sup>	1 8 <sup>20</sup>
22		2 6 <sup>20</sup>	14 1 <sup>20</sup>	24 0 <sup>20</sup>	0 8 <sup>20</sup>			58 5 <sup>20</sup>		0 2 <sup>11</sup>
23		3 3 <sup>20</sup>	8 2 <sup>20</sup>	4 8 <sup>20</sup>	0 5 <sup>20</sup>			30 3 <sup>20</sup>	57 3 <sup>20</sup>	1 1 <sup>11</sup> , 1 0 <sup>21</sup> , 5 1 0 <sup>22</sup>
24	←11 3 <sup>23</sup> →							6 2		82 5 <sup>21</sup>
25		Trace	6 9	2 3	0 1			84 4	4 6	
26		1 4	40 1	5 5				42 7	10 3	
27	46 9	14 1	8 8	1 3		2 7 <sup>2</sup> , 7 0 <sup>3</sup>		18 5	0 7	
28			8 3	3 1	2 4			56 0	26 0	3 1 <sup>11</sup> , 1 1 <sup>21</sup>
29	←9 6 <sup>23</sup> →							17 8		17 5
30			4 8 <sup>20</sup>	2 9 <sup>20</sup>				30 1 <sup>20</sup>	62 2 <sup>20</sup>	
31			1					32	15	50 <sup>22</sup>
32	←6 8 <sup>23</sup> →							18 6	70 1	3 4
33			9 1	4 3	0 8			45 4	40 4	
34	0 2	0 1	9 8	2 4	0 9		0 4	28 9	50 7	0 1 <sup>7</sup>
35			5 6	2 2	0 9			25 1	66 2	
36	←4 6 <sup>23</sup> →							4 1	0 6	90 7 <sup>20</sup>
37	←16 0 <sup>23</sup> →							28 1	52 3	3 6

<sup>13</sup> C<sub>22</sub> polyethenoic <sup>14</sup> Behenic <sup>15</sup> C<sub>14</sub> polyethenoic <sup>16</sup> Gadoleic <sup>17</sup> C<sub>21</sub> polyethenoic. <sup>18</sup> Ricinoleic. <sup>19</sup> Includes behenic and lignoceric <sup>20</sup> Percent by weight <sup>21</sup> Lignoceric <sup>22</sup> Erucic <sup>23</sup> Includes behenic <sup>21</sup> Licanic <sup>20</sup> Eleostearic

## WAXES

These data for waxes were compiled originally for the Biology Data Book by A H Warth Data are reproduced here by permission of the copyright owners of the above publication, the American Societies for Experimental Biology, Washington, D C p 382

**Specific Gravity** (column C) was calculated at the specified temperature, degrees centigrade, and referred to water at the same temperature **Density**, shown in parentheses (column C), and **Refractive Index** (column D) were measured at the specified temperature, degrees centigrade

	Wax	Melting Point °C	Specific Gravity or (Density)	Refractive Index $n_{\frac{D}{C}}$	Iodine Value	Acid Value	Saponifi- cation Value
	(A)	(B)	(C)	(D)	(E)	(F)	(G)
1	Bamboo leaf	79-80	(0 961 <sup>25°</sup> )		7 8 <sup>1</sup>	14 5	43 4
2	Bayberry (myrtle)	46 7-48 8	(0 985 <sup>15°</sup> )	1 436 <sup>80°</sup>	2 9 <sup>2</sup> -3 9 <sup>3</sup>	3 5	20 5-21 7
3	Beeswax, crude	62-66	(0 927-0 970 <sup>15°</sup> )	1 439-1 483 <sup>40°</sup>	6 8-16 4 <sup>2</sup>	16 8-35 8	89 3-149 0
4	Beeswax, white, U S P	61-69	(0 959-0 975 <sup>15°</sup> )	1 447-1 465 <sup>65°</sup>	7-11 <sup>3</sup>	17-24	90-96
5	Beeswax, yellow	62-65	(0 960-0 964 <sup>15°</sup> )	1 443-1 449 <sup>65°</sup>	6-11	18-24	90-97
6	Candelilla, refined	67-69	(0 982-0 986 <sup>15°</sup> )	1 454-1 463 <sup>85°</sup>	14 4-20 4	12 7-18 1	35-86
7	Cape berry <sup>4</sup>	40 5-45 0	(1 004-1 007 <sup>15°</sup> )	1 450 <sup>45°</sup>	0 6-2 4	2 5-3 7	211-215
8	Carandá	79 7-84 5	(0 990 <sup>25°</sup> )		8 0-8 9	5 0-9 5	64 5-78 5
9	Carnauba	83-86	0 990-1 001 <sup>15°</sup>	1 467-1 472 <sup>40°</sup>	7 2-13 5	2 9-9 7	78-95
10	Castor oil, hydro- genated	83-88	(0 980-0 990 <sup>20°</sup> )		2 5-8 5	1 0-5 0	177-181
11	Chinese insect	81 5-84 0	0 950-0 970 <sup>15°</sup>	1 457 <sup>40°</sup>	1 4	0 2-1 5	73-93
12	Cotton	68-71	0 959 <sup>15°</sup>		24 5	32	70 6
13	Cranberry	207-218	(0 970-0 975 <sup>15°</sup> )		44 2-53 2 <sup>2</sup>	42 2-59 1	131-134
14	Douglas-fir bark	59 0-72 8	(1 030 <sup>25°</sup> )	1 468 <sup>80°</sup>	25 8-62 5	58 6-80 7	112-200
15	Esparto	67 5-78 1	0 988 <sup>15°</sup>		22-23	22 7-23 9	69 8-79 3
16	Flax	61 5-69 8	0 908-0 985 <sup>15°</sup>		21 6-28 8	17 5-48 3	77 5-101 5
17	Ghedda, E Indian beeswax	60 5-66 4	0 956-0 973 <sup>15°</sup>	1 440 <sup>50°</sup>	5 6-12 6	5 8-7 9	84 5-118 3
18	Indian corn	80-81			4 2 <sup>2</sup>	1 9	120 3
19	Japan wax	48-53	0 975-0 993 <sup>15°</sup>		4 5-12 5	6-20	206 5-237 5
20	Jojoba	11 2-11 8	0 864-0 899 <sup>25°</sup>	1 465 <sup>25°</sup>	81 7-88 4 <sup>2</sup>	0 2-0 6	92 2-95 0
21	Madagascar	88			3 2-5 3	17 7-28 0	140 0-159 6
22	Microcrystalline, amber	64-91	0 913-0 943 <sup>15°</sup>	1 424-1 452 <sup>80°</sup>	0	0	0
23	Microcrystalline, white	71-89	0 928-0 941 <sup>15°</sup>	1 441 <sup>80°</sup>	0	0	0
24	Montan, crude	76-86	(1 010-1 020 <sup>25°</sup> )		13 9-17 6	22 7-31 0	59 4-92 0
25	Montan, refined	77-84	(1 010-1 030 <sup>25°</sup> )		10-14	24-43	72-103
26	Orange peel	44 0-46 5	0 985 <sup>15°</sup>	1 502 <sup>20°</sup>	115 7 <sup>2</sup>	48 3	120 9
27	Ouricury, refined	79 0-83 8	1 053 <sup>15°</sup>		6 9-7 8 <sup>2</sup>	3 4-21 1	61 8-85 8
28	Ozocerite, refined	74 4-75 0	0 907-0 920 <sup>15°</sup>		0	0	0
29	Palm	74-86	(0 991-1 045 <sup>15°</sup> )		8 9-16 9 <sup>2</sup>	5 0-10 6	64 5-104 0
30	Paraffin, American	49-63	0 896-0 925 <sup>15°</sup>	1 442-1 448 <sup>80°</sup>	0	0	0
31	Peat wax, natural	73-76	0 980 <sup>15°</sup>		16-40	60 0-73 3	73 9-136 0
32	Rice bran, refined	75 3-79 9		1 469 <sup>30°</sup>	11 1-19 4	15-17	56 9-104 4
33	Shellac wax	79-82	0 971-0 980 <sup>15°</sup>		6 0-8 8 <sup>3</sup>	12 1-24 3	63 8-83 0
34	Sisal hemp	74-81	1 007-1 010 <sup>15°</sup>		28-29 <sup>2</sup>	16-19 <sup>2</sup>	56-58
35	Sorghum grain	77-82			15 7-20 9	10 1-16 2	16-44
36	Spanish moss	79-80			33 0	25 0	120 4
37	Spermaceti	42-50	0 905-0 945 <sup>15°</sup>	1 440 <sup>70°</sup>	4 8-5 9	2 0-5 2	108-134
38	Sugarcane, crude	52-67	0 988-0 998 <sup>25°</sup>		32-84	24-57	128-177
39	Sugarcane, double- refined	77-82	0 961-0 979 <sup>25°</sup>	1 510 <sup>25°</sup>	13-29	8-23	55-95
40	Wool wax, refined	36-43	0 932-0 945 <sup>15°</sup>	1 478-1 482 <sup>40°</sup>	15 0-46 9	5 6-22 0	80-127

<sup>1</sup> Wijs test <sup>2</sup> Hanus test <sup>3</sup> Hubl test <sup>4</sup> *Myrica cordifolia*

## DIAMAGNETIC SUSCEPTIBILITIES OF ORGANIC COMPOUNDS

Compiled by George W. Smith

The following table contains values for the molar susceptibility of  $\chi_M$ , specific susceptibility  $\chi$  and volumetric susceptibility  $K$ . The cgs Gaussian system of units is employed. In the Gaussian units the relation between magnetic induction  $B$  and magnetic field strength  $H$  is

$$B = H + 4\pi I \quad (1)$$

where  $I$  is the magnetization or magnetic moment per unit volume. Actually the quantities involved in equation (1) are all vectors but one may assume that all three are collinear. A reasonable assumption for organic diamagnetic substances in the liquid state. For crystals  $I$  may vary with crystal orientation. Equation (1) may be rewritten

$$B = H + 4\pi KH = (1 + 4\pi K)H \quad (2)$$

Here,  $K$  is the magnetic susceptibility often called the volumetric susceptibility and is a unitless quantity.

Other susceptibilities of use to chemists and physicists are the specific or mass susceptibility which is defined

$$\chi = K/\rho \quad (3)$$

where  $\rho$  is the density of the sample in grams per cc, and the molar susceptibility which is defined as

$$\chi_M = M\chi = MK/\rho \quad (4)$$

where  $M$  is the molecular weight of the substance in grams.

Temperatures, when listed, are enclosed in parentheses and are listed in degrees C.

Literature references for values contained in this table may be found in General Motors Research Laboratories publication GMR-317.

Compound	$-\chi_M \times 10^6$	$-\chi \times 10^6$	$-K \times 10^6$	Compound	$-\chi_M \times 10^6$	$-\chi \times 10^6$	$-K \times 10^6$
Acenaphthanthracene	184	73		Amyl iodide	(118.7)	5996 (18°)	(910) (20°)
Acenaphthene	109.3	(709)	(726) (99°)	n-Amyl methyl ketone	80.50	707 <sub>2</sub>	(580) (15°)
Acetal	81.39	688 (32°)	(568) (32°)	Amyl nitrate	(76.4)	574	
Acetaldehyde	22.70	515 <sub>3</sub>	(403) (18°)	iso-Amyl propionate	101.73	705 <sub>1</sub> (25°)	(609) (25°)
Acetamide	34.1	577	(618) (20°)	n-Amyl valerate	124.55	723 <sub>9</sub>	(638) (0°)
Acetic acid	31.54	525 (32°)	(551) (32°)	Anethole	(96.0)	648	(644) (15°)
Acetic anhydride	(52.8)	517	(562) (15°)	Aniline	62.95	(676)	(691) (20°)
Acetoaminofluorene	(141)	63		Anisidine	(80.5)	654	(72) (20°)
Acetone	33.7 <sub>5</sub>	581 <sub>1</sub>	(460) (20°)	Anisole	72.79	(673)	(672) (15°)
Acetonitrile	28.0	(682)	(534) (20°)	Anthanthrene	204.2	739	
Acetylacetone	62.51	547 <sub>6</sub>	(531) (20°)	Anthanthrone	178.1	581	
Acetophenone	72.05	599 <sub>8</sub>	(615) (20°)	Anthracene	(130)	731	(914) (27°)
Acetophenone oxime	79.9 <sub>6</sub>	592 <sub>6</sub>		Anthracenedimtrile	154.6	(678)	
Acetophenone oxime-O-methyl ether	92.3 <sub>1</sub>	618 <sub>5</sub>		Anthracenonitrile	142.1	(700)	
Acetoxime	44.4 <sub>1</sub>	607 <sub>6</sub>	(480) (20°)	Anthraquinone	(119.6)	575	(825) (20°)
Acetoxime-O-benzyl ether	104.8 <sub>9</sub>	642		Anthrazine	245.7	646	
Acetoxime-O-methyl ether	54.8	629 <sub>8</sub>		Arabinose	85.70	571	(905) (20°)
Acetylacetone	54.88	548 <sub>1</sub>	(535) (20°)	Arbutoside	158.0	(589)	
Acetyl chloride	38.9	496	(548) (20°)	Asarone	131.4	(631)	(735) (18°)
Acetylene	12.5	(480)		Asparagine	69.5	(526)	(812) (15°)
Acetylphenylacetylene	86.9	508		Aspartic acid	64.2 ± 4	(482)	(800) (12°)
Acetylthiophene	71.7	(568)		Aurin	(161.4)	556	
Acridine	(123.3)	688	(757) (20°)	p-Azoanisole	(147.7)	610	
Adonitol	91.30	600		Azobenzene	(106.8)	586	611 (70.5°)
Alanine	50.5	(567)		p-Azophenetole	(171.7)	635	
Allyl acetate	(56.7)	566	(525) (20°)	m-Azotoluene	(127.8)	608	643 (58°)
Allyl alcohol	36.70	632	540 (20°)	Azulene	98.5	768	
1-Allylpyrrole	73.80	685 (20°)		Barbituric acid (Anh.)	53.8	(420)	
Aminoazobenzene	(118.3)	600		Barbituric acid (2H·O)	78.6	(479)	
Aminoazotoluene	(142.2)	631		Benzalazine	(123.7)	594	
o-Aminoazotoluene	(138)	61 ± 02		Benzaldehyde	60.78	(573)	(602) (15°)
α-Aminobutyric acid	62.1	(602)		Benzaldoxime	(60.8)	576	(639) (20°)
Aminomethyl-diethyl-diazine	114.8	(696)		Benzamide	(72.3)	597	(801) (4°)
4-Aminostilbene	122.5	(628)		Benzanthrone	142.9	620	
2-Aminothiazole	56.0	564		Benzene	54.84	702 (32°)	611
n-Amyl acetate	89.06	684 <sub>5</sub>	5979 (20.7°)	Benzidine	110.9	603	(754) (20°)
n-Amyl acetate	89.40	687	599 (20°)	Benzil	(118.6)	564	616 (100°)
n-Amyl alcohol	(67.5)	766	(624) (20°)	Benzoin acid	70.28	(575)	(728) (15°)
γ-Amyl alcohol	(71.0)	8060	(655) (25°)	Benzoin anhydride	(124.9)	552	(662) (15°)
Inactive Amyl alcohol	69.06	783 <sub>1</sub> (25°)		Benzonitrile	65.19	(632)	(638) (15°)
iso-Amyl alcohol	68.96	782 <sub>2</sub> (25°)	(64) (15°)	Benzophenone	109.60	601 <sub>3</sub>	(66) (50°)
sec-Amyl alcohol	69.1	785	(635) (20°)	3,4-Benzopyrene	135.7	538	
tert-Amyl alcohol	(70.9)	804	(654) (15°)	Benzopyrene	194.0	586	(620) (60°)
n-Amylamine	69.4	(796)	(606) (20°)	Benzoyl acetone	(95.0)	539 (20°)	(657) (15°)
iso-Amylamine	71.6	(821)	(616) (20°)	Benzoyl chloride	(75.8)	589	(655) (16°)
n-Amylbenzene	112.55	(759)	(652) (20°)	Benzyl acetate	93.18	(620)	(687) (15°)
iso-Amyl bromide	(88.7)	587	(706) (20°)	Benzyl alcohol	71.83	(664)	(690) (19°)
iso-Amyl-n-butyrate	113.52	717 <sub>1</sub> (25°)	(616) (25°)	Benzylamine	75.26	(702)	(713) (18°)
iso-Amyl chloride	(79.0)	741	(662) (20°)	Benzyl chloride	81.98	(647)	(646) (20°)
iso-Amyl cyanide	73.4	(755)	(609) (20°)	Benzyl formate	81.43	(598)	
iso-Amylene	53.7	766		Benzylideneaniline	(100.4)	554	
Amylene bromide	(114.5)	498		Benzylidene chloride	(97.9)	608	(763) (14°)
Amylene chloride	(95.2)	675		Benzylidenemethylamine	(73.1)	613	
iso-Amyl ether	(129)	813	(635) (15°)	Benzyl methyl ketone	83.44	621 <sub>9</sub>	(624) (20°)
iso-Amyl formate	78.38	674 <sub>8</sub>	(591) (25°)	Bibenzyl	(126.8)	696	671 (54.5°)
Amylidene chloride	(93.4)	662					

DIAMAGNETIC SUSCEPTIBILITIES OF ORGANIC COMPOUNDS (Continued)

Compound	$-\chi_M \times 10^6$	$-\chi \times 10^6$	$-K \times 10^6$	Compound	$-\chi_M \times 10^6$	$-\chi \times 10^6$	$-K \times 10^6$
3,4-Bis (p-hydroxyphenyl)-2,4-hexadiene	(157)	59		Chlorofumaric acid	67.02	(445)	
m,m-Bitolyl	(127.4)	6993 (27.4°)	(699) (16°)	p-Chloroiodo benzene	99.42	(417)	(786) (57°)
m,m'-Bitolyl sulfide	(140.0)	6530 (27.4°)		Chloromaleic acid	67.36	(448)	
Borneol	126.0	(817)	(826) (20°)	Chloromethylstilbene	144.8	(633)	
Bromobenzene	78.92	3030 (20°)	(753) (20°)	$\alpha$ -Chloronaphthalene	107.60	661	789 (20°)
Bromobenzenediazocyanide	86.88	(414)		m-Chloronitrobenzene	(74.8)	475	638 (48°)
Bromochloromethane	55.0 $\pm$ 6	(425)	(846) (19°)	o-Chlorophenol	77.4	(602)	(747) (18°)
Bromodichloromethane	66.3 $\pm$ 3	(405)	(812) (15°)	p-Chlorophenol	77.6	(604)	(789) (20°)
Bromoform	82.60	327	948 (20°)	1-( $\alpha$ -Chlorophenylazo) 2 naphthol	161.0	(570)	
Bromonaphthalene	(123.8)	598		1-( $\beta$ -Chlorophenylazo) 2 naphthol	161.4	(571)	
$\alpha$ -Bromonaphthalene	115.90	560	840 (20°)	Chlorotrifluoroethylene	49.1	422	
m-Bromotoluene	(93.4)	546	(770) (20°)	Chlorotrifluoromethane	45.3 $\pm$ 1.5	(434)	
Bromotrichloromethane	73.1 $\pm$ 7	(389)	(758) (0°)	Cholesterol	(284.2)	735	(784) (20°)
Butane	57.4	(988)		Chrysene	166.67	731	
iso-Butane	51.7	(890)		Chrysoidine	(126.3)	595	
1,4-Butanediol	61.5	(682)	(696) (20°)	Cinnamic acid	78.36	529	(660) (4°)
2-Butene (cis)	42.5	(759)		Cinnamic acid ( $\alpha$ trans)	78.2	(528)	
2-Butene (trans)	42.6	(759)		Cinnamic acid ( $\beta$ trans)	79.0	(533)	
1-Butene 3,4-diacetate	43.3	(772)		Cinnamic acid (cis MP 68°)	77.6	(534)	
2-Butene-1,4-diacetate (cis)	95.5	(555)		Cinnamic acid (cis-MP 38°)	77.9	(526)	
2-Butene-1,4-diacetate (trans)	95.2	(553)		Cinnamic acid (cis-MP 42°)	83.2	(562)	
2-Butene 1,4 diol (cis)	54.3	(616)		Cinnamic aldehyde	(74.8)	566	(629) (15°)
2-Butene 1,4 diol (trans)	53.5	(607)		Cinnamyl alcohol	(87.2)	650	(679) (20°)
n-Butyl acetate	77.47	666 <sub>6</sub> (25°)	(583) (25°)	Cinnamylideneaniline	123.2	(595)	
iso-Butyl acetate	78.52	676 <sub>6</sub>	(584) (25°)	Citral	(98.9)	650	(577) (20°)
n-Butyl alcohol	56.536 (20°)	(7627)	(6176) (20°)	Coronene	(243.3)	810	
iso-Butyl alcohol	57.704 (20°)	(7785)	(624) (20°)	Coumarin	82.5	(565)	(528) (20°)
sec-Butyl alcohol	57.683 (20°)	(7782)	(629) (20°)	o-Cresol	72.90	675	(706) (20°)
tert-Butyl alcohol	57.42	774 (25°)	(611) (20°)	m-Cresol	72.02	667 (26°)	(690) (20°)
n-Butylamine	58.9	(805)	(596) (20°)	p-Cresol	72.1	667 (25°)	(690) (20°)
iso-Butylamine	59.8	(818)	(599) (20°)	o-Cresylmethyl ether	81.94	671 (40°)	(661) (15°)
9-Butyl anthracene	176.0	(751)		m-Cresylmethyl ether	77.91	638 (40°)	(623) (15°)
n-Butylbenzene	100.79	(751)	(646) (20°)	p-Cresylmethyl ether	79.13	648 (40°)	(629) (19°)
iso-Butylbenzene	101.81	(759)	(648) (20°)	Cumene	89.53	744 <sub>9</sub>	(642)
tert-Butylbenzene	102.5	(764)	(662) (20°)	Camelide	(56.1)	435	490 (15°)
n-Butyl benzoate	116.69	654 <sub>4</sub>	(676) (25°)	Cameluric acid	101.1 (10°)	(457)	
Butyl bromide	77.14	563 (20°)	(730) (20°)	9-Cyanoanthracene	142.1	(699)	
iso-Butyl bromide	79.88	583 (20°)	(737) (20°)	Cyanogen	(21.6)	415	(359) (liq 17°)
1-n-Butyl chloride	67.10	725	642 (20°)	Cyanuric acid	61.5	476	(842) (10°)
2-n-Butyl chloride	67.40	728	635 (20°)	Cyclobutanecarboxylic acid	58.16	5816 (30°)	(613) (30°)
n-Butyl cyanide	(62.8)	7558 (27.4°)	(606) (20°)	1,3-Cyclohexadiene	48.6	(607)	(510) (20°)
tert-Butyl cyclohexane	115.09	8205	6670 (20°)	1,4-Cyclohexadiene	48.7	(608)	(515) (20°)
1,4-Butyl diacetate	103.4	(594)		Cyclohexane	68.13	8100 (27.5°)	(627) (20°)
n-Butyl ethyl ketone	80.73	707 <sub>7</sub>	(579) (20°)	Cyclohexanecarboxylic acid	83.24	6499 (30°)	(668) (30°)
n-Butyl formate	65.83	644 <sub>4</sub>	(571) (25°)	Cyclohexanol	73.40	732	694 (20°)
iso-Butyl formate	66.79	654 <sub>9</sub>	(574) (25°)	Cyclohexanone	62.0	632 <sub>2</sub>	(599) (20°)
iso-Butylideneazime	(95.8)	683		Cyclohexanone oxime	71.5 <sub>5</sub>	632 <sub>1</sub>	
Butyl iodide	(93.6)	5086 (18°)	(822) (20°)	Cyclohexanoneoxime O-methyl ether	82.9 <sub>6</sub>	652 <sub>2</sub>	
iso-Butyl methyl ketone	70.05	699 <sub>5</sub>	(561) (20°)	Cyclohexene	57.5	(700)	(567) (20°)
tert-Butyl methyl ketone	69.86	697 <sub>7</sub>	(558) (16°)	Cyclohexenol	64.1	(653)	
n-Butyl perfluor n-butyl rate	126.7	(460)		Cyclooctane	91.4	(815)	(684) (20°)
p-tert-Butylphenol	108.0	(719)	(653) (114°)	Cyclooctene	84.6	(769)	(654) (20°)
Butyl sulfide	(113.7)	7774 (27.4°)	(652) (16°)	Cyclooctatetraene	(53.9)	518	
Butyl thiocyanate	(79.38)	6891 (27.4°)	(659) (25°)	Cyclopentane	59.18	8439	6290 (20°)
2-Butyne 1,4 diacetate	95.9	(564)		Cyclopentanecarboxylic acid	73.48	6446 (30°)	(677) (30°)
2-Butyne 1,4 dibenzoate	169.0	(561)		Cyclopentanone	51.63	6141 (30°)	(582) (30°)
2-Butyne-1,4-diol	50.3	(584)		Cyclopropane	39.9	(948)	(683) (-79°)
n-Butylaldehyde	46.08	639 <sub>9</sub>	(522) (20°)	Cyclopropanecarboxylic acid	45.33	5271 (30°)	(569) (30°)
iso-Butylaldehyde	46.38	643 <sub>8</sub>	(511) (20°)	p-Cymene	102.8	766 (20°)	(656) (20°)
Carbon tetrachloride	56.1	644 <sub>3</sub>	(576) (20°)	Decalin	106.70	7718	6814 (20°)
n-Butyric acid	55.10	625	598 (20°)	cis-Decalin	(107.0)	774	(686) (35°)
iso-Butyric acid	56.06	636 <sub>3</sub> (25°)	(601) (25°)	trans-Decalin	(107.7)	779	(670) (35°)
Butyronitrile	49.4	(715)	(569) (15°)	n-Decane	119.74	(8416)	(6143) (20°)
Butylphenylacetylene	(106.4)	618		1-Deuterio pyrrole	48.75	716 (20°)	
(acetyl)	(99.9)	476	(689) (15°)	Deuterioundene	60.88	690	(692) (13°)
Carbonylic acid	(79.9)	579		Diacetal	(153.8)	668	
Camphor	(103)	68	(67) (25°)	Di-iso-amylamine	(133.1)	846	(649) (21°)
Camphoric acid	129.0	(644)	(791) (20°)	Diazoacetate ester	57	(50)	(54) (24°)
Camphoric anhydride	(113)	620	(740) (20°)	Dibenzocoronene	289.4	778	
n-Capric acid	78.55	676	(624) (25°)	1,2,5,6-Dibenzofluorene	184	69 $\pm$ 03	
n-Caprylic acid	(130.4)	651		3,4,5,6-Dibenzophenanthrene	(203)	73 $\pm$ 03	
Carbanilide	101.60	7053	(642) (20°)	Dibenzphenanthrone	200.5	716	
Carbazole	134.05	(6316)	(783) (20°)	Dibenzpyrene	213.6	706	
Carbon disulfide	117.4	(702)		Dibenzpyrenequinone	183.1	551	
Carbon tetrabromide	42.2	554	699 (22°)	iso-Dibenzpyrenequinone	194.6	586	
Carbon tetrachloride	93.73	2826 (20°)	(966)	Dibenzyl ketone	131.70	626 <sub>6</sub>	786 (100°)
Carbon tetraiodide	66.60	433	691 (20°)	p-Dibromobenzene	(101.4)	430	
Carvacrol	(109.1)	726	(709) (20°)	2,3-Dibromo-2-butene-1,4-diol	94.2	(383)	
Carvone	(92.2)	614	(590) (20°)	Dibromodichloromethane	81.1 $\pm$ 4	(334)	(808) (25°)
Cetyl alcohol	(183.5)	757 (17.5°)	(619) (50°)	1,2-Dibromodiodoethylene	(140.1)	320	
Cetyl mercaptan	390.4	1510		1,2-Dibromoethylene	(71.7)	386	(877) (17.5°)
Chloral	(67.7)	459	(694) (20°)	1,2-Dibromo-2-fluoroethane	(78.0)	379	(855) (17°)
Chloranil	(112.6)	458		Dibromo-4-nitrophenol	(167.5)	564	
Chloroacetic acid	48.1	(509)	(804) (20°)	1,2-Dibromotetrachloroethane	(126.0)	387	(1049)
Chloroacetone	(50.9)	550	(633) (20°)	Di-n-butylamine	103.7	(802)	(767) (20°)
Chloroacetylchloride	53.7	(475)	(710) (0°)	Di-iso-butylamine	105.7	(817)	(609) (20°)
p-Cloranisole	89.1	(625)		Di-sec-butylamine	105.9	(819)	(641) (0°)
Chlorobenzene	69.97	(6216)	(688) (20°)	Di-tert-butyl ketone	104.30	733 <sub>3</sub>	(591) (20°)
Chlorobenzene diazocyanide	65.02	(393)		Di-tert-butyl ketone	101.06	732 <sub>1</sub>	
Chlorodibromomethane	75.1 $\pm$ 4	(361)	(883) (15°)	2,4-Di-tert-butyl-4-methyl phenol	165.3	(750)	
Chlorodifluoromethane	38.6	446		2,4-Di-tert-butyl phenol	155.6	(754)	
1-Cloro-2,3-dihydroxypropane	(77.9)	604		Dibutyl phthalate	175.1	(629)	(657) (21°)
Chlorodiphenylmethane	131.9	(651)		Di-iso-butylalacetylene	(125.6)	738	
Chloroethylene	35.9	574	(528) (liq 15°)	Dicetyl sulfide	401.7	(832)	
Chloroform	59.30	497	740 (20°)	Dichloroacetic acid	58.2	(451)	(705) (20°)
				Dichloroacetyl chloride	69.0	(468)	

DIAMAGNETIC SUSCEPTIBILITIES OF ORGANIC COMPOUNDS (Continued)

Compound	$-x_M \times 10^6$	$-x \times 10^6$	$-K \times 10^6$	Compound	$-x_M \times 10^6$	$-x \times 10^6$	$-K \times 10^6$
o-Dichlorobenzene	84 26	5734	(748) (20°)	2,5-Dimethylpyrrole	71 92	756 (20°)	(707) (20°)
m-Dichlorobenzene	83 19	5661	(729) (20°)	$\alpha$ - $\omega$ -Dimethyl styrene	(90 7)	686	
p-Dichlorobenzene	82 93	5644	(823) (20 5°)	Dimethyl succinate	81 50	5581	(625) (18°)
1,4-Dichloro-2-butene	74 2	(603)		Dimethyl sulfate	(82 2)	493	(657) (20°)
1,2-Dichloro-1,2-dibromoethane	(108 6)	423		Dimethyl sulfide	(44 9)	723	(612) (21°)
1,1-Dichloro-difluoroethylene	60 0	451		Dimethyltrichloromethylcarbinol	(105)	59	
Dichlorodifluoromethane	52 2	432	(642) (-30°)	N,N-Dimethyl urea	55 1	(625)	(784)
1,1-Dichloroethylene	49 2	508	(635) (15°)	N,N'-Dimethyl urea	56 3	(639)	(730)
cis-1,2-Dichloroethylene	51 0	526	(679) (15°)	o-Dinitrobenzene	65 98	3921	(614) (17°)
trans 1,2-Dichloroethylene	48 9	504	(638) (15°)	m-Dinitrobenzene	70 53	4197	(659) (0°)
1,3-Dichloro-2-hydroxypropane	(80 1)	621		p-Dinitrobenzene	68 30	4064	(660) (30°)
Dicyandiamide	44 55	(530)	(742) (14°)	2,4-Dinitrophenol	(73 1)	397	(668) (24°)
Dicyclohexanol acetylene	(151 6)	682		Dinitrosorecinol	(62 4)	312	
Dicyclohexyl	129 31	7776	6889 (20°)	1,4-Dioxane	52 16	592 (32°)	(606) (32°)
1,1-Dicyclohexylnonane	231 98	7930	7001 (20°)	Diphenyl	103 25	6695	(664) (73°)
Diethanolacetylene	(75 3)	660		1,1-Diphenylallyl-3-chloride	146 1	(639)	
Diethyl acetaldehyde	70 71	7055	(576) (20°)	1,3-Diphenylallyl-3-chloride	140 7	(615)	
Diethylallylacetophenone	146 2	(676)	(663) (16°)	Diphenylamine	(109 7)	648	686 (55 5°)
Diethyl allylmalonate	118 8	(593)	(602) (14°)	Diphenylbis-diazo cyanide	85 03	(327)	
Diethylamine	56 8	(777)	(552) (18°)	Diphenylbutadiene	129 6	(629)	
Diethylcyclohexylamine	(124 5)	802	(699) (0°)	Diphenylchloroarsine	(145 5)	550	(871) (40°)
Diethyl ethylmalonate	115 2	(612)	(614) (20°)	Diphenyldecapentaene	180 5	(635)	
Diethyl ketone	58 14	6755	(551) (19°)	Diphenylidacetylene	(134 6)	640	
Diethyl ketoxime	68 31	6754		Diphenyldiazomethane	115	(592)	
Diethyl malonate	(92 6)	5782	(611) (20°)	Diphenyldihydrotetrazine	129 9	(545)	
Diethyl-3-(1-methyl butane) ethyl-malonate	175	(677)		1,1-Diphenylethylene	(118 0)	655	(680) (14°)
Diethyl oxalate	81 71	5595	(603) (15°)	1,6-Diphenylhexane	171 81	7208	6877 (20°)
Diethyl phthalate	127 5	(574)	(645) (25°)	Diphenylhexatriene	146 9	(632)	
Diethyl sebacate	(177 0)	685	(661) (20°)	Diphenylmethane	(115 7)	688	684 (35 5°)
Diethylstilbestrol	172 0	(547)		Diphenylmethanol	119 1	647	
Diethylstilbestrol dipropionate	265 2	720		1,1-Diphenylnonane	206 32	7357	6935 (20°)
Diethyl succinate	105 07	6035	(628) (20°)	Diphenyloctatetraene	164 3	(636)	
Diethyl sulfate	(86 8)	563	(667) (15°)	Diphenylphenoxyarsine	(225 2)	567	
Diethyl sulfide	(67 9)	753	(630) (20°)	N,N-Diphenyl urea	126 3	(595)	(759)
Diethyl tartrate	(113 4)	550	(662) (20°)	N,N'-Diphenyl urea	127 5	(600)	(743) (20°)
Difluoroacetamide	(41 2)	433		Di-n-propyl ketone	80 45	7056	(576) (20°)
1-Difluoro-2-dibromoethane	(85 5)	382	(883) (20°)	Di iso-propyl ketone	81 14	7116	(628) (0°)
1,1-Difluoro-2,2-dichloroethyl amyl ether	129 84	(587)	(694) (20°)	Dipropyl oxalate	105 27	6046	
1,1-Difluoro-2,2-dichloroethyl butyl ether	119 48	(577)	(703) (20°)	Di iso-propyl oxalate	106 02	6089	
1,1-Difluoro-2,2-dichloroethyl ethyl ether	96 13	(537)	(723) (20°)	Dodecyl alcohol	147 70	7849 (20 7°)	(652) (24°)
1,1-Difluoro-2,2-dichloroethyl methyl ether	80 68	(489)	(696) (20°)	Dulcitol	112 40	617	(905) (15°)
1,1-Difluoro-2,2-dichloroethyl propyl ether	107 19	(555)	(701) (20°)	Fladic acid	204 8	(725)	(619) (79°)
Difluoroethanol	(41 3)	503		Erythritol	73 80	604	(876) (20°)
Di-n-heptylamine	171 5	(805)		Ethane	27 3	(910)	(511) (-102°)
Di-n-hexylamine	148 9	(803)		4-Ethoxy-3-methoxybenzyl acetate	138 5	619	
Dihydronaphthalene	(85 1)	654	(652) (12°)	4-Ethoxy-3-methoxybenzyl benzoate	177 3	620	
o-Dimethoxybenzene	87 39	6329	(686) (25°)	1-Ethoxynaphthalene	119 9	(696)	(738) (20°)
m-Dimethoxybenzene	87 21	6316	(682) (0°)	2-Ethoxynaphthalene	119 2	(692)	(734) (25°)
p-Dimethoxybenzene	86 65	6275	(661) (55°)	Ethyl acetate	54 10	614	554 (20°)
o-(2,5-Dimethoxybenzoyl)-benzoic acid	161 0	(562)		Ethyl acetoacetate	71 67	5506	(565) (20°)
Dimethoxymethane	(47 3)	621	(532)	Ethyl acetophenone	95 5	(644)	(639) (16°)
Dimethylacetophenone	96 8	(653)	(645) (16°)	Ethyl alcohol	33 60	724	575 (20°)
Dimethylallylacetophenone	122 4	(650)	(635) (16°)	l-ethylallyl acetophenone	122 5	(651)	(634) (16°)
Dimethylaniline	89 66	(740)		F-ethyl amylpropionate	(112 7)	670	
2,2-Dimethylbutane	76 24	8848	5744 (20°)	F-ethylamine	89 30	(737)	(709)
2,3-Dimethylbutane	76 22	8845	5853 (20°)	9-Ethyl anthracene	153 0	(741)	(771) (99°)
2,3-Dimethyl-2-butene	65 9	(783)	(557)	Ethylbenzene	97 20	7272	6311 (20°)
Dimethylcyclohexanone	(84 8)	672		Ethyl benzoate	93 32	6211	(648) (25°)
1,2 and 1,3 Dimethylcyclopentanes	81 31	8281	6224 (20°)	Ethyl benzoate	93 32	6211	(673) (20°)
2,5-Dimethyl-2,5-dibromo-3-hexine	(135 6)	506		F-ethyl benzoylacetate	(115 3)	578	
Dimethyl diethylketo tetrahydrofurfurane	(116 2)	753		F-ethyl benzylideneacyanoacetate	(116 3)	578	
2,5-Dimethyl 1-ethylpyrrole	94 61	768 (20°)		F-ethyl benzylmalonate	(154 5)	6172	(663) (20°)
2,5-Dimethyl 3-ethylpyrrole	93 87	762 (20°)		F-ethyl bromide	54 70	502	719 (20°)
2,5-Dimethylfuran	66 37	687 (20°)	(620) (18°)	F-ethyl bromoacetate	(82 8)	496	(747) (20°)
Dimethyl furazan	57 27	584		F-ethyl-1-isobutylacetoacetate	(121 4)	652	
2,5-Dimethyl-4-heptene	100 6	(797)		F-ethyl butylmalonate	139 3	644-	(629) (20°)
2,4-Dimethyl-2,4-hexadiene	(78 7)	714		Ethyl n-butyrate	(77 7)	6693	585 (25°)
2,3-Dimethylhexane	98 77	8648	6164 (20°)	F-ethyl iso-butyrate	78 32	6743	(583) (25°)
2,5-Dimethylhexane	98 15	8593	5969 (20°)	Ethyl chloroacetate	(72 3)	590	(684) (20°)
3,4-Dimethylhexane	99 06	8673	6240 (20°)	F-ethyl cinnamate	(107 5)	610	(640) (20°)
2,6-Dimethyl-4 hexanol	116 9	812		l-ethyl-iso-cyanate	(45 6)	642	(582) (16°)
2,5-Dimethyl 3 hexene-2,5-diol	(103 0)	724		Ethyl cyanoacetate	(67 3)	595	(632) (20°)
Dimethyl isoxazole	59 7	(615)		F-ethylcyclohexane	91 09	8118	6324 (20°)
Dimethylketo tetrahydrofurfurane	(68 5)	600		l-Ethylallylacetophenone	147 4	(646)	(636) (16°)
Dimethyl malonate	69 69	5277	(609) (20°)	Ethyl dibromocinnamate	174 5	519	
1,6-Dimethylnaphthalene	113 3	(725)		F-ethyl dichloroacetate	85 2	(543)	(696) (20°)
2,4-Dimethylnonane	134 68	(862)	(636) (20°)	F-ethyl diethylacetoacetate	(117 9)	6328	(615) (20°)
3,4-Dimethylnonane	134 70	(862)	(647) (20°)	F-ethyl diethylmalonate	(140 4)	6492	(641) (20°)
4,5-Dimethylnonane	134 52	(861)	(647) (20°)	F-ethyl dithiolacetate	(71 0)	5904 (27 4°)	
2,6-Dimethyl-2,6,8-nonatriene	(108 8)	724		F-ethylene	12 0	(428)	(242) (-102°)
Dimethyl-2,4-nonatriene	(148 8)	990		Ethylene	15 30	546 (32°)	(309) (-102°)
2,6-Dimethyloctane	122 54	(861)	(627) (20°)	Ethylene bromide	78 80	419	915 (20°)
3,4-Dimethylloxadiazole	57 17	583		Ethylene chloride	59 62	602 (32°)	(757) (20°)
Dimethyl oxalate	(55 7)	472	(542) (54°)	Ethylene diamine	46 26	771 (32°)	(686) (20°)
Dimethyl oxamide	(62 2)	544		Ethylene iodide	104 7	371 (32°)	(791) (10°)
2,2-Dimethylpentane	86 97	8680	5849 (20°)	Ethylene oxide	30 7	(697)	(618) (7°)
2,3-Dimethylpentane	87 51	8733	6070 (20°)	F-ethyl ether	55 10	743	531 (20°)
2,4-Dimethylpentane	87 48	8732	5876 (20°)	Ethyl ethylacetoacetate	93 9	5937	(582) (20°)
2,2-Dimethylpropane	63 1	(875)	(536) (0°)	Ethyl ethylbutylmalonate	(163 3)	6683	(650) (20°)
2,5-Dimethyl-3-propyl-pyrrole	106 07	773 (20°)		F-ethyl ethylpropylmalonate	(152 4)	6619	(648) (20°)
2,4-Dimethylpyrrole	69 64	732 (20°)	(679) (14°)	Ethyl formate	43 00	580	531 (20°)
				Ethyl hexylpropionate	129 9	713	
				Ethyl hydroxylamine	(43 0)	704	
				Ethylidene chloride	(57 4)	580	(681) (20°)
				Ethyl iodide	(69 7)	4470 (17 5°)	(864) (20°)
				Ethyl iodoacetate	(97 6)	456	(829) (13°)
				Ethyl lactate	(72 6)	615	(633) (25°)



DIAMAGNETIC SUSCEPTIBILITIES OF ORGANIC COMPOUNDS (Continued)

Compound	$-\chi_M \times 10^6$	$-\chi \times 10^6$	$-K \times 10^6$	Compound	$-\chi_M \times 10^6$	$-\chi \times 10^6$	$-K \times 10^6$
Ethyl methylacetoacetate	(81 9)	5684	(569) (20°)	Indene (natural)	84 79	(730)	(723) (25°)
Ethyl methyl ketoxime	57 3 <sub>2</sub>	6586	(530) (20°)	Indene (synthetic)	80 89	(696)	(690) (25°)
Ethyl-1-methyl-2-oxocyclohexane-carboxylate	112 1	(608)		Indole	85 0	(726)	
Ethyl methylphenylmalonate	(153 2)	6121	(658) (20°)	Iodobenzene	92 00	451	826 (20°)
Ethyl nitrophenylpropionate	114 6	523		Iodoform (in sol'n)	117 1	2974 (20°)	(1 192) (17°)
Ethyl oxamate	62 0	(529)	(427) (19°)	1 Iodo-2 phenylacetylene	(110 1)	483	
Ethyl perfluor-n-butylate	103 5	(427)		o-Iodotoluene	(112 2)	5145 (30°)	(874) (20°)
Ethyl phenylacetate	104 27	(635)	(656) (20°)	m-Iodotoluene	(112 3)	5152 (30°)	(875) (20°)
Ethyl phenylmalonate	(142 2)	6017	(659) (20°)	p-Iodotoluene	101 31	(465)	(780) (40°)
Ethyl phenylpropionate	(104 2)	598	(636) (13°)	Leucine	84 9	(647)	
Ethyl phosphate	(98 2)	539	(576) (25°)	iso-Leucine	84 9	(647)	
Ethyl propionate	(66 5)	6514	(584) (15°)	Maleic acid	49 71	(428)	(681) (20°)
Ethyl propylacetoacetate	(105 7)	6135	(593) (20°)	Maleic anhydride	(35 8)	365	(341) (20°)
Ethyl-n-propyl ketone	69 03	6891	(560) (22°)	Malonic acid	(46 3)	4453	(726) (15°)
Ethyl succinimide	(72 0)	566		Mannitol	111 20	610	(908) (20°)
Ethyl sulfine	(67 0)	631		Mannose	102 90	571	(879)
Ethyl sulfite	(75 4)	546	(604) (0°)	Mesitylene	92 32	7682 (20°)	(665) (20°)
Ethylsulfone ethyl ether	(81 8)	592		Methane	12 2	(765)	
Ethyl thiocyanate	(55 7)	6392 (27 4°)	(637) (25°)	Methone	91 0	(610)	
Ethyl isothiocyanate	(59 0)	6772 (27 4°)	(680) (15°)	p-Methoxyazobenzene	(118 9)	560	
Ethyl thioacetate	(62 7)	6019 (27 4°)	(586) (25°)	o-Methoxybenzaldehyde	76 0	(558)	(632) (20°)
Ethyl thionacetate	(63 5)	6098 (27 4°)	(637) (25°)	p-Methoxybenzaldehyde	78 0	(572)	(642) (20°)
Ethyl tribromoacetate	(119 5)	368	(821) (20°)	o-Methoxybenzyl alcohol	87 9	637	(664) (25°)
Ethyl trichloroacetate	(99 6)	520	(719) (20°)	1-Methoxynaphthalene	107 0	(676)	(741) (14°)
N-Ethyl urea	55 5	(630)	(764) (18°)	2-Methoxynaphthalene	107 6	(680)	
Ethyl iso valerate	(91 1)	700	(607) (20°)	1 (o-Methoxyphenylazo)-2-naphthol	163 6	(588)	
Eucalyptol	(116 3)	754	(699) (20°)	Methoxysalgenin acetate	110 3	613	
Eugenol and iso-eugenol	(102 1)	622	(663) (20°)	Methyl acetate	42 60	575	537 (20°)
Flavanthron	241 0	590		Methyl acetoacetate	59 60	513 <sub>2</sub>	(553) (20°)
Fluorene	110 5	655		Methylacetylacetone	(65 0)	569	
Fluorenone	99 4	552	(623) (100°)	Methyl alcohol	21 40	668	530 (20°)
Fluorobenzene	(58 4)	608	(623) (20°)	Methyl allyl ketone	111 9	(1 330)	
Fluorobromoacetic acid	(59 5)	379		Methylamine	(27 0)	870	(608) (-11°)
Fluorodichloromethane	48 8	474	(676) (0°)	N Methylamine	82 74	(773)	(762) (20°)
p-Fluorophenole	(88 0)	628		9-Methylanthracene	146 5	762	(812) (99°)
Fluoro trichloroethylene	72 5	485	(742) (25°)	Methyl benzoate	81 59	599 <sub>2</sub>	(651) (25°)
Fluorotrchloromethane	58 7	427	(638) (17°)	Methyl-o-benzoylbenzoate	139 4	(580)	(690) (19°)
Formaldehyde	(18 6)	62	(51) (-20°)	Methyl benzyllaniline	(132 2)	670	
Formamide	(21 9)	486	(551) (20°)	Methyl bromide	42 8	451	(1 044) (0°)
Formic acid	19 90	432	527 (20°)	2-Methylbutane	64 40	8925	5531 (20°)
β-Formylpropionic acid	55 3	(542)		2-Methyl-2-butene	54 14	(772)	(516) (13°)
Fructose	102 60	570		Methyl butyl ketone	(69 1)	690	(563) (15°)
Fulvene (Benzene $\chi_M$ measured to be 49)	42 9	(549)	(452) (20°)	Methyl iso-butyl ketone	(69 3)	692	(554) (20°)
Fulvene ( $\chi \frac{54.8}{49}$ )	48 0	(614)	(505) (20°)	Methyl tert-butyl ketone	(70 4)	703	(562) (16°)
Fumaric acid	49 11	(423)	(692) (20°)	p-Methyl-o-tert butylphenol	120 3	(732)	
Furan	43 09	633 (20°)	(598) (15°)	Methyl butyrate	(66 4)	6498	(588) (16°)
Furfural	47 1	(490)	(568) (20°)	o-Methylcarbanilide	154 0	(681)	
Galactose	103 00	572		Methyl chloride	(32 0)	633	
Gallic acid	90 0	(529)	(896) (4°)	Methyl chloroacetate	58 1	(535)	(661) (20°)
Geraniol formate	(119 9)	658	(610) (20°)	Methylcholanthrene	(182)	68 ± 04	
Glucose	102 60	570		3-Methylcholanthrene	194 0	(723)	
D-Glucose	101 5	(563)	(869) (25°)	Methylcyclohexane	78 91	8038	6181 (20°)
Glutamic acid	78 5	(533)		2-Methylcyclohexanone	(74 0)	660	(610) (18°)
Glycerol	57 06	619	779 (20°)	3-Methylcyclohexanone	(74 8)	667	(610) (20°)
Glycine	40 3	(537)	(846) (50°)	4-Methylcyclohexanone	(63 5)	566	(516) (24°)
Glycol	38 80	624	698 (20°)	Methylcyclopentane	70 17	8338	6245 (20°)
Guaiacol	(79 2)	638	(720) (21°)	4-Methyl-2,6-di tert-butylphenol	167 6	(761)	
Helianthron	189 9	497		Methyl dichloroacetate	73 1	(511)	
1,2-Heptadiene	73 5	(764)		Methyldiphenoxyphosphine oxide	(152 9)	616	
2,3-Heptadiene	72 1	(749)		Methyldiphenyltriazine	(155 1)	627	
Heptaldehyde	81 02	709 <sub>6</sub>	(603) (20°)	Methylene bromide	65 10	375	935 (20°)
n-Heptane	85 24	8507	5817 (20°)	Methylene chloride	(46 6)	549	(733) (20°)
4-Heptanol	91 5	789	(647) (20°)	Methylene iodide	93 10	348	1 156 (20°)
n-Heptanoic acid	88 60	680	626 (20°)	Methylene succinic acid	57 57	(443)	(723)
n-Heptyl amine	93 1	(808)	(628) (20°)	Methyl ether	26 3	571	
n-Heptyl benzene	134 41	7625	6528 (20°)	Methylethylallylacetophenone	133 3	(659)	(643) (16°)
Heptyl cyclohexane	147 40	8084	6559 (20°)	Methyl ethyl ketone	45 5 <sub>6</sub>	632 <sub>2</sub>	(509) (20°)
n-Heptylic acid	89 74	6900	(630) (25°)	Methyl formate	(32 0)	5327	(519) (20°)
1-Heptyne	77 0	(801)	(584) (25°)	Methylfumaric acid	56 98	(438)	(642)
2-Heptyne	79 5	(826)	(615) (25°)	3-Methylheptane	97 99	8580	6056 (20°)
Hexabromoethane	(148 0)	294	(1 124) (20°)	2-Methyl-4 heptene	88 0	(784)	
Hexachlorobenzene	(147 5)	518	(1 059) (24°)	5-Methyl-1,2 hexadiene	73 6	(765)	(553) (19°)
Hexachloroethane	(112 7)	476	(995) (20°)	2-Methylhexane	86 24	8607	5841 (20°)
Hexachlorohexatrone	(145 0)	433		Methyl hexyl ketone	(93 3)	728	(596) (20°)
n-Hexadecane	187 63	8286	6421 (20°)	Methyl-m-hydroxybenzoate	88 4	(581)	
1,5-Hexadiene	(55 1)	671	(462) (20°)	Methyl p-hydroxybenzoate	88 7	(583)	
2,3-Hexadiene	60 9	(741)		Methyl iodide	(57 2)	403	(918) (20°)
n Hexaldehyde	69 40	693 <sub>6</sub>		Methylmaleic acid	57 84	(446)	(721)
2,2,4,7,9,9-Hexamethyldecane	191 52	8458	6596 (20°)	9-Methyl-10 methoxyanthracene	158 1	(711)	
Hexamethyl disloxane	118 9	7324		Methyl-o-methoxybenzoate	95 6	(575)	(665) (19°)
Hexamethylene glycol	84 30	715		Methyl-p-methoxybenzoate	98 6	(593)	
n-Hexane	(74 6)	8654 (27 4°)	(565)	Methyl-α-methoxy isobutyrate	(81 9)	620	
Hexene	65 7	(781)		1-Methylnaphthalene	102 8	(723)	(741) (14°)
Hexestrol	(165)	61 ± 02		2-Methylnaphthalene	102 6	(722)	(743) (20°)
n-Hexyl alcohol	79 20	774	637 (20°)	4-Methylnonane	121 39	(853)	(625) (20°)
n-Hexyl benzene	124 23 (20°)	(767)	(658) (20°)	5-Methyl-5-nonene	111 6	(796)	
n-Hexyl methyl ketone	91 4	713 <sub>1</sub>	(583)	4-Methyloctane	109 63	(855)	(618) (20°)
n-Hexyl methyl ketoxime	102 5 <sub>8</sub>	716 <sub>2</sub>	(634) (20°)	Methylol urea	48 3	(493)	
Hexylpropiolamide	(103 7)	677		2 Methylpentane	75 26	8734	5705 (20°)
Hydrindene	(78 5)	664	(639) (16°)	3-Methylpentane	75 52	8764	5823 (20°)
Hydroquinone	64 63	587	(797) (20°)	4-Methyl 2-pentanol	80 4	788	(641) (20°)
Hydroxyazobenzene	(99 7)	503		Methyl perfluor-n-butylate	92 5	(406)	
p-Hydroxybenzaldehyde	66 8	(547)	(618) (130°)	Methyl phenylacetate	92 73	(618)	(645) (16°)
4-Hydroxy-2-butanone	48 5	55	(573) (14°)	Methyl phenylpropionate	95 6	597	
				2-Methylpropene	44 4	(791)	
				Methyl propionate	(55 0)	6240	(571) (20°)

DIAMAGNETIC SUSCEPTIBILITIES OF ORGANIC COMPOUNDS (Continued)

Compound	$-X_M \times 10^6$	$-X \times 10^6$	$-K \times 10^6$	Compound	$-X_M \times 10^6$	$-X \times 10^6$	$-K \times 10^6$
Methyl n-propyl ketone	57 41	666	( 541) (15°)	Pentachloroethane	(99 1)	490	( 819) (25°)
Methyl-iso-propyl ketone	58 45	679 <sub>0</sub>	( 545) (20°)	Pentachlorohexadione	(129 5)	452	
1 Methylpyrrole	58 56	722 (20°)	( 664) (10°)	2,3 Pentadiene	49 1	( 721)	( 501) (20°)
2-Methylpyrrole	60 10	741 (20°)	( 700)	n-Pentane	63 05	8739	5472 (20°)
Methyl salicylate	86 30	567	668 (20°)	2,4 Pentanediol	70 4	677	
Methyl silicone	(127 7)	730		Perfluoroacetic acid	43 3	( 380)	
$\alpha$ -Methyl styrene	(80 1)	678	( 620) (20°)	Perfluoro n-butyric acid	81 0	( 378)	
2-Methylthiazole	59 56	601 (20°)		Perfluorobutyric anhydride	149 4	( 387)	
2-Methylthiophene	66 35	676 (20°)	( 689) (20°)	Perfluorocyclooctane oxide	157 6	( 379)	
Methyl trichloroacetate	84 2	( 475)	( 707) (19°)	Perfluoropropionic acid	61 0	( 372)	
N-Methyl urea	44 6	( 602)	( 725)	Perhydroanthracene	146 01	7592	7178 (20°)
Morpholine	55 0	( 631)	( 631)	Perylene	166 8	662	
Myleran	169 7	69	( 834) (4°)	Phenanthrene	(127 9)	718	( 763) (100°)
Myristic acid	176 0	( 771)	( 661) (60°)	Phenanthrenequinone	104 5	502	( 698)
Naphthalaldehydic acid	117 6	( 588)		Phenanthrenonitrile	139 0	( 685)	
Naphthalene	(91 9)	717	( 821) (20°)	o-Phenetidine	(101 7)	741 (25°)	
Naphthalene picrate	185 9	( 523)		p-Phenetidine	(96 8)	706 (25°)	( 749) (15°)
2-Naphthalenesulfonylamine	127 6	( 616)		Phenetole	(84 5)	692	( 689) (20°)
2-Naphthalenesulfonyl chloride	121 91	( 538)		Phenol	60 21	( 640)	( 675) (45°)
meso-Naphthodianthrene	214 6	612		Phenothiazine	114 8	( 576)	
meso-Naphthodianthrene	221 8	583		Phenylacetaldehyde	72 01	599 <sub>4</sub>	( 614) (20°)
1-Naphthol	98 2	681	( 834) (4°)	Phenyl acetate	82 04	( 603)	( 647) (25°)
2-Naphthol	98 25	673	( 819) (4°)	Phenylacetic acid	82 72	( 608)	( 657) (80°)
$\alpha$ -Naphthomtrile	103 3	( 674)	( 829) (4°)	Phenylacetylene	72 01	( 705)	( 655) (20°)
$\beta$ -Naphthomtrile	101 0	( 659)	( 753) (5°)	1-Phenylazo-2 naphthol	137 6	( 554)	
$\alpha$ -Naphthoquinone	73 5	( 465)	( 721) (60°)	2-Phenylbenzofuran	130 5	( 672)	
$\beta$ -Naphthoquinone	67 9	( 429)	( 661)	1 Phenyl 4-benzoyl 1,3 butadiene	(140 3)	599	
N-1-Naphthylacetamide	117 8	( 636)		Phenylbutadiene	(85 7)	658	
N-2-Naphthylacetamide	117 8	( 636)		4 Phenyl 1-butene	93 49	( 7077)	( 6239) (20°)
1-Naphthylamine	98 8	690	757 (54°)	Phenylbutyl acetate	134 5	653	
2-Naphthylamine	98 00	( 684)	( 726) (98°)	Phenyl n-butyrate	105 46	( 643)	
1-Naphthylamine hydrochloride	(127 6)	710		Phenyl iso-cyanate	(72 7)	610	( 699) (20°)
Nicotene	113 328	( 699)	( 705) (20°)	o-Phenylenediamine	71 98	6662	
o-Nitroaniline	66 47	( 481)	( 694) (15°)	m-Phenylenediamine	70 53	6529	( 723) (58°)
m-Nitroaniline	70 09	( 507)	( 725) (20°)	p-Phenylenediamine	70 28	6503	
p-Nitroaniline	66 43	( 481)	( 691) (14°)	Phenyl ether	(108 1)	635	( 681) (20°)
o-Nitrobenzaldehyde	68 23	4517		Phenylethyl sulfide	(94 4)	6826 (27 4°)	
m-Nitrobenzaldehyde	68 55	4538		Phenylfluorofom	(77 3)	529	
p-Nitrobenzaldehyde	66 57	4407	( 507) (0°)	Phenylhydrazine	67 82	( 627)	( 688) (23°)
Nitrobenzene	61 80	502	604 (20°)	Phenylhydroxylamine	(68 2)	625	
Nitrobenzene diazo cyanide	59 22	( 336)		Phenyl mercaptan	(70 8)	6425 (27 4°)	( 693) (20°)
o-Nitrobenzoic acid	76 11	4556	( 718) (4°)	1-Phenyl 2 Methylbutane	113 53	( 766)	( 660) (20°)
m-Nitrobenzoic acid	80 22	4802	( 717) (4°)	Phenylmethyl sulfide	(83 2)	6695 (27 4°)	
p-Nitrobenzoic acid	78 81	4718	( 731) (32°)	Phenyl isopropylamide	(83 3)	574	
o-Nitrobromobenzene	87 3	( 432)	( 700) (80°)	Phenyl propionate	93 79	( 625)	( 654) (25°)
m-Nitrobromobenzene	89 5	( 443)	( 755) (20°)	Phenylsulfone	(129 0)	591	( 740) (30°)
p-Nitrobromobenzene	89 6	( 444)	( 859) (22°)	Phenyl thiocyanate	(81 5)	6027 (27 4°)	( 677) (24°)
m-Nitro carbanilide	148 1	( 376)		Phenyl isothiocyanate	(86 0)	6365 (27 4°)	( 719) (24°)
Nitroethane	(35 4)	472	( 497) (20°)	1-Phenyl 4,6,6-trimethylheptane	173 90	( 796)	( 682) (20°)
Nitromethane	21 1	3457	( 391) (25°)	N-Phenyl urea	82 1	( 603)	( 785)
1-Nitronaphthalene	98 47	( 569)	( 696) (62°)	Phloroglucinol	(73 4)	582	
o-Nitrophenol	73 3	527 (24°)	( 873) (20°)	Phthalamide	(91 3)	556	
m-Nitrophenol	70 8	509 (25°)	( 756)	Phthalic acid	83 61	5035	( 802) (20°)
p-Nitrophenol	69 5	500 (22°)	( 740)	iso Phthalic acid	84 64	5097	
1-(m-Nitrophenylazo)-2-naphthol	142 0	( 484)		tere-Phthalic acid	83 51	5029	( 759)
1-(p-Nitrophenylazo)-2-naphthol	141 7	( 483)		Phthalic anhydride	67 31	( 454)	( 694) (4°)
Nitrophenylfluorofom	(84 1)	440		Phthalimide	(78 4)	533	
2-Nitropropane	45 73	5135	( 509) (20°)	Picric acid	84 38	( 368)	( 649)
Nitrosobenzene	59 1	( 552)		Piperazine	56 8	( 659)	
N-Nitrosodiethylamine	59 3	( 580)	( 546) (20°)	Piperidine	64 2	( 754)	( 650) (20°)
p-Nitrosodiethylamine	92 6	( 520)	( 644) (15°)	Propane	40 5	( 919)	( 538) (-45°)
p-Nitrosodimethylamine	73 3	( 488)		Propene	31 5	( 749)	( 456) (-47°)
N-Nitrosodiphenylamine	110 7	( 558)		Propionaldehyde	34 32	5916	( 477) (20°)
1-Nitroso-2-naphthol	83 9	( 485)		Propionic acid	43 50	586	582 (20°)
2-Nitroso-1-naphthol	82 7	( 478)		Propionitrile	38 5	( 699)	( 547) (21°)
4-Nitroso-1-naphthol	91 8	( 530)		Propionylphenylacetylene	(95 1)	601	
m-Nitrosnitrobenzene	66 0	( 433)		Propiophenone	83 73	624 <sub>0</sub>	( 631) (20°)
p-Nitrosnitrobenzene	65 8	( 433)		n-Propyl acetate	65 91	645 <sub>0</sub> (25°)	( 569) (25°)
p-Nitrosophenol	50 7	( 412)		iso Propyl acetate	67 04	656 <sub>4</sub>	( 566) (25°)
Nitrosopiperidine	(63 4)	555	( 590) (20°)	n-Propyl alcohol	45 176 (20°)	( 7518)	( 6047) (20°)
p-Nitrosotoluene	70 4	( 581)		iso-Propyl alcohol	45 794 (20°)	( 7621)	( 5985) (20°)
o-Nitrotoluene	72 28	5272	( 613) (20°)	9-Propylantracene	164 0	( 744)	
m-Nitrotoluene	72 71	5304	( 614) (20°)	n-Propylbenzene	89 24	( 742)	( 640) (20°)
p-Nitrotoluene (in sol'n)	72 06	5257	( 676) (20°)	n-Propyl benzoate	103 00	( 640)	( 646) (25°)
n-Nonane	108 13	8431	6057 (20°)	n-Propyl bromide	(65 6)	533	( 721) (20°)
1,2-Octadiene	83 6	( 759)		iso-Propyl bromide	(65 1)	529	( 633) (20°)
n-Octane	96 63	8460	5949 (20°)	Propyl butyrate	(89 4)	6867	( 604) (15°)
Octanonoxime	(102 7)	717		prim-Propyl chloride	56 10	715	633 (20°)
Octyl alcohol	102 65	7766 (20°)		iso-Propyl cyclohexane	102 65	8131	6528 (20°)
Octyl chloride	(114 9)	773	( 640) (20°)	Propylenediamine	(58 1)	784	( 688) (15°)
Octylcyclohexane	158 09	8051	( 676) (20°)	Propylene oxide	42 5	( 732)	( 629) (0°)
Octylene	(89 5)	798	6578 (20°)	Propyl formate	(55 0)	6218	( 563) (20°)
Octylene bromide	(150 4)	553	( 576) (17°)	Propyl isopropylate	(136 8)	697	
n-Octyl mercaptan	(115 1)	7866 (27 4°)		Propyl iodide	(84 3)	4958 (30°)	( 864) (20°)
Oenanthyldiene chloride	(116 5)	689		Propyl propionate (extrap)	(77 95)	6711	( 593) (20°)
Oleic acid	208 5	( 738)	( 661) (18°)	Propyl sulfide	(92 1)	7787 (27 4°)	( 634) (17°)
Opionic acid	111 5	( 530)		N-Propyl urea	67 4	( 660)	
Ovalene	353 8	888		Pseudocumene	(101 6)	845 (20°)	( 740) (20°)
Oxalic acid (anh.)	33 8	( 375)		Pyramdone	149 0	( 645)	
Oxalic acid	60 05	( 4763)	( 787)	Pyranthrene	266 9	709	
Oxamide	(39 0)	443	( 738)	Pyranthrone	250 3	616	( 484) (61°)
Palmitic acid	198 6	( 775)	( 661) (62°)	Pyrazine	37 6	( 469)	( 933) (0°)
Paraldehyde	(86 2)	652	( 648) (20°)	Pyrene	147 9	731	( 611) (20°)
Pentabromophenol	(194 0)	397		Pyridine	49 21	( 622)	( 857) (15°)
Pentacene	(205 4)	738		Pyrocatechol	68 76	6248	( 688) (20°)
				Pyrrole	47 6	( 709)	

**DIAMAGNETIC SUSCEPTIBILITIES OF ORGANIC COMPOUNDS (Continued)**

Compound	$-X_M \times 10^6$	$-X \times 10^6$	$-K \times 10^6$	Compound	$-X_M \times 10^6$	$-X \times 10^6$	$-K \times 10^6$
Pyrrolidine	54.8	(771)	(657) (23°)	Triaminophosphine oxide	(201.7)	624	
Quinoline	86.0	(666)	(729) (20°)	1,2,3-Tribromopropane	(117.9)	420	(1023) (23°)
Quinone	38.4	(355)	(468) (20°)	Tri-iso-butylamine	(156.8)	846	(646) (25°)
Quinonoxime	(50.4)	409		Trichloroacetic acid (in sol n)	73.0	(44)	(723) (46°)
Resorcinol	67.26	6112	(785) (15°)	Trichlorobenzene	(106.5)	587	
Rhamnose	99.20	605	(890) (20°)	Trichloro-tert-butyl alcohol (in sol n)	98.01	552	
Safrol and iso-Safrol	(97.5)	601	(66) (20°)	Trichloroethylene	65.8	501	(734) (20°)
Salicylaldehyde	64.4	(527)	(615) (20°)	Trichloronitromethane	(75.3)	458	(756) (20°)
Salicylic acid	72.23	523	(751) (20°)	Triethylamine	81.4	(804)	(586) (20°)
Saligenin	76.9	620	(720) (25°)	Triethyl citrate	(161.9)	586	(666) (20°)
Salol	(123.2)	575	678 (45°)	Triethyl phosphate	(125.3)	688	(735) (20°)
Salvarsan dihydrochloride	(246.1)	518		Triethylphosphine	(90.0)	762	(610) (15°)
Selenophene	66.82	510		Triethylphosphine oxide	(91.6)	683	
iso-Selenophene	110-111	84-85		Triethyl phosphite	(104.8)	631	(611) (20°)
trans-Selenophene	70-77	53 59		Triethyl triazetricarbonate	(164.1)	552	
Sorbitol	107.80	592		Trifluorocresol	(83.8)	517	
Stearic acid	220.8	(776)	(657) (69°)	Tri-n heptylamine	251.3	(806)	
Stilbene	(120.0)	666	(646) (125°)	Tri-n hexylamine	221.7	(823)	
Stilbestrol	(130)	62 63		Trimethylacetophenone	108.2	(667)	(648) (16°)
styrene	(68.2)	655	(594) (20°)	2,2,3-Trimethylbutane	88.36	8818	6086 (20°)
Succinic acid	(57.9)	4902	(767) (15°)	2,2,3-Trimethylpentane	99.86	8743	6261 (20°)
Succinic anhydride	(47.5)	475	(524)	2,2,4-Trimethylpentane	98.34	8610	5958 (20°)
Succinimide	(47.3)	477	(674) (16°)	2,3,5-Trimethylpyrrole	82.31	754 (20°)	
Sulfamide	44.4	(462)	(832)	1,3,5-Trinitrobenzene	74.55	(350)	(591) (20°)
p-Sulfanilamide	80.15	(465)		Triperfluorobutylamine	253.0	(377)	
Terpineol	111.9	(725)	(678) (room temp)	Triphenoxyarsine	(195.2)	551	
				Triphenylarsine	(177.0)	578	
Tetrabenzylmonosilane	266.2	(678)		Triphenylarsine dihydroxide	(270.5)	795	
1,1,2,2-Tetrabromoethane	(123.4)	357	(1058) (20°)	Triphenylarsine oxide	(199.1)	618	
Tetrabromoethylene	(114.8)	334		Triphenylbismuthine	(196.8)	447	(708) (20°)
Tetracene	(168.0)	736		Triphenylbismuthine dinitrate	(254.5)	451	
1,1,2,2-Tetrachloroethane	(89.8)	535	(856) (20°)	Triphenylcarbinol	(175.7)	675	(802) (20°)
Tetrachloroethylene	81.6	492	(802) (15°)	Triphenylmethane	(165.6)	678	686 (100°)
Tetrahydroquinoline	(89.0)	668	(715) (4°)	Triphenylphosphine	(166.8)	636	(759)
Tetraiodoethylene	(164.3)	309	(922) (20°)	Triphenyl phosphite	(183.7)	592	(701) (18°)
Tetraiodopyrrole	(188.9)	331		Triphenylstibine	(182.2)	516	
Tetramethylketotetrahydrofuran	(104.7)	736		Triphenylstibine dihydroxide	(238.5)	616	
Tetranitromethane	43.02	2195	(360) (20°)	N,N',N'' Triphenyl urea	176.5	(613)	
Tetraphenylbutadiene	228.0	(636)		Triquinoyl	(133.0)	426	
Tetraphenyldecapentaene	280.8	(643)		Tropolone	61	50	
Tetraphenylhexatriene	246.4	(641)		Tryptophan	132.0	(646)	
Tetraphenyloctatetraene	264.1	(643)		Tyrosine	105.3	(581)	
Tetraphenylrhubene	344.0	(646)		Undecane	131.84	(8435)	(6247) (20°)
Tetra-p-tolylmonosilane	276.4	(704)		Urea	33.4	(556)	(742) (20°)
Tetrolac acetal	(97.8)	688		Urethan	(57)	64	(63) (21°)
Tetronic acid	(52.5)	525		iso-Valeraldehyde	(57.5)	668	(536) (17°)
Thiacoumeron	93.6	577		n-Valeric acid	66.85	6548	(617) (20°)
Thiazole	50.55	595 (20°)	(714) (17°)	iso-Valeric acid	(67.7)	663	(621) (15°)
Thioarbuturic acid	72.9	(506)		Valerylphenylacetylene	(119.0)	639	
Thiophene	57.38	682 (20°)	(726) (20°)	Valne	74.3	(634)	
Tolane	(118.9)	667	(644) (100°)	Violanthrene	273.5	641	
Toluene	66.11	7176	6179 (20°)	Violanthrone	204.8	449	
o-Toluidine	76.0	710 (24°)	(709) (20°)	iso-Violanthrone	215.9	473	
m-Toluidine	74.6	697 (25°)	(689) (20°)	Water	(13.00)	7218 (20°)	(7205) (20°)
p-Toluidine	72.1	673 (25°)	(704) (20°)	Water (value usually used as standard)	(12.97)	720 (20°)	(719) (20°)
α-Tolunitrile	76.87	(656)	(666) (18°)	Xanthone	(108.1)	551	
1-(o-Tolylazo)-2-naphthol	148.7	(567)		o-Xylene	77.78	7327	6440 (20°)
1-(p-Tolylazo)-2-naphthol	157.6	(601)		m-Xylene	76.56	7212	6235 (20°)
Triallylacetophenone	152.5	(634)		p-Xylene	76.78	7232	6226 (20°)
Tri-iso-amyamine	192	845	(647) (25°)	Xylose	84.80	565	(862) (20°)

## FOUR-PLACE LOGARITHMS

N											Proportional Parts								
	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
10	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374	*4	8	12	17	21	25	29	33	37
11	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755	4	8	11	15	19	23	26	30	34
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106	3	7	10	14	17	21	24	28	31
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430	3	6	10	13	16	19	23	26	29
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732	3	6	9	12	15	18	21	24	27
15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014	*3	6	8	11	14	17	20	22	25
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279	3	5	8	11	13	16	18	21	24
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529	2	5	7	10	12	15	17	20	22
18	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765	2	5	7	9	12	14	16	19	21
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	2	4	7	9	11	13	16	18	20
20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	2	4	6	8	11	13	15	17	19
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	2	4	6	8	10	12	14	16	18
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	2	4	6	8	10	12	14	15	17
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	2	4	6	7	9	11	13	15	17
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	2	4	5	7	9	11	12	14	16
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	2	3	5	7	9	10	12	14	15
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298	2	3	5	7	8	10	11	13	15
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	2	3	5	6	8	9	11	13	14
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	2	3	5	6	8	9	11	12	14
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	1	3	4	6	7	9	10	12	13
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	1	3	4	6	7	9	10	11	13
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	1	3	4	6	7	8	10	11	12
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172	1	3	4	5	7	8	9	11	12
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	1	3	4	5	6	8	9	10	12
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	1	3	4	5	6	8	9	10	11
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551	1	2	4	5	6	7	9	10	11
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670	1	2	4	5	6	7	8	10	11
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	1	2	3	5	6	7	8	9	10
38	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899	1	2	3	5	6	7	8	9	10
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	1	2	3	4	5	7	8	9	10
40	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117	1	2	3	4	5	6	8	9	10
41	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222	1	2	3	4	5	6	7	8	9
42	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325	1	2	3	4	5	6	7	8	9
43	6335	6345	6355	6365	6375	6385	6395	6405	6415	6425	1	2	3	4	5	6	7	8	9
44	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522	1	2	3	4	5	6	7	8	9
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618	1	2	3	4	5	6	7	8	9
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712	1	2	3	4	5	6	7	7	8
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	1	2	3	4	5	5	6	7	8
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893	1	2	3	4	4	5	6	7	8
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	1	2	3	4	4	5	6	7	8
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067	1	2	3	3	4	5	6	7	8
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	1	2	3	3	4	5	6	7	8
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	1	2	2	3	4	5	6	7	7
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316	1	2	2	3	4	5	6	6	7
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	1	2	2	3	4	5	6	6	7
N	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

\* Interpolation in this section of the table is inaccurate.

**FOUR-PLACE LOGARITHMS (Continued)**

N											Proportional Parts								
	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	1	2	2	3	4	5	5	6	7
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	1	2	2	3	4	5	5	6	7
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	1	2	2	3	4	5	5	6	7
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	1	1	2	3	4	4	5	6	7
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	1	1	2	3	4	4	5	6	7
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	1	1	2	3	4	4	5	6	6
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	1	1	2	3	4	4	5	6	6
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	1	1	2	3	3	4	5	6	6
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	1	1	2	3	3	4	5	5	6
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	1	1	2	3	3	4	5	5	6
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189	1	1	2	3	3	4	5	5	6
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	1	1	2	3	3	4	5	5	6
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	1	1	2	3	3	4	5	5	6
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382	1	1	2	3	3	4	4	5	6
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445	1	1	2	2	3	4	4	5	6
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506	1	1	2	2	3	4	4	5	6
71	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567	1	1	2	2	3	4	4	5	5
72	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627	1	1	2	2	3	4	4	5	5
73	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	1	1	2	2	3	4	4	5	5
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	1	1	2	2	3	4	4	5	5
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	1	1	2	2	3	3	4	5	5
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	1	1	2	2	3	3	4	5	5
77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	1	1	2	2	3	3	4	4	5
78	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971	1	1	2	2	3	3	4	4	5
79	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025	1	1	2	2	3	3	4	4	5
80	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079	1	1	2	2	3	3	4	4	5
81	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133	1	1	2	2	3	3	4	4	5
82	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186	1	1	2	2	3	3	4	4	5
83	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238	1	1	2	2	3	3	4	4	5
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	1	1	2	2	3	3	4	4	5
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	1	1	2	2	3	3	4	4	5
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	1	1	2	2	3	3	4	4	5
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440	0	1	1	2	2	3	3	4	4
88	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489	0	1	1	2	2	3	3	4	4
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	0	1	1	2	2	3	3	4	4
90	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586	0	1	1	2	2	3	3	4	4
91	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633	0	1	1	2	2	3	3	4	4
92	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680	0	1	1	2	2	3	3	4	4
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	0	1	1	2	2	3	3	4	4
94	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773	0	1	1	2	2	3	3	4	4
95	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818	0	1	1	2	2	3	3	4	4
96	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	0	1	1	2	2	3	3	4	4
97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	0	1	1	2	2	3	3	4	4
98	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	0	1	1	2	2	3	3	4	4
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	0	1	1	2	2	3	3	3	4
N	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

PERIODIC TABLE OF THE ELEMENTS

1a	2a	3b	4b	5b	6b	7b	8	1b	2b	3a	4a	5a	6a	7a	0	Orbit		
<b>1</b> <b>H</b> 1.00797 1 +1 -1		Atomic Number → <b>50</b> +2 ← Oxidation States Symbol → <b>Sn</b> +4 ← KEY TO CHART Atomic Weight → <b>118.69</b> ← Electron Configuration -18-18-4										<b>2</b> <b>He</b> 4.0026 2 0	K					
<b>3</b> <b>Li</b> 6.939 2-1 +1	<b>4</b> <b>Be</b> 9.0122 2-2 +2									<b>5</b> <b>B</b> 10.811 2-3 +3	<b>6</b> <b>C</b> 12.01115 2-4 +2 +4 -4	<b>7</b> <b>N</b> 14.0067 2-5 +1 +2 +3 +4 +5 -1	<b>8</b> <b>O</b> 15.9994 2-6 -2	<b>9</b> <b>F</b> 18.9984 2-7 -1	<b>10</b> <b>Ne</b> 20.183 2-8 0	K-L		
<b>11</b> <b>Na</b> 22.9898 2-8-1 +1	<b>12</b> <b>Mg</b> 24.312 2-8-2 +2	Transition Elements						Transition Elements		<b>13</b> <b>Al</b> 26.9815 2-8-3 +3	<b>14</b> <b>Si</b> 28.086 2-8-4 +2 +4 -4	<b>15</b> <b>P</b> 30.9738 2-8-5 +3 +5 -3	<b>16</b> <b>S</b> 32.064 2-8-6 +4 +6 -2	<b>17</b> <b>Cl</b> 35.453 2-8-7 +1 +5 +7 -1	<b>18</b> <b>Ar</b> 39.948 2-8-8 0	K-L-M		
		Group 8																
<b>19</b> <b>K</b> 39.102 -8-8-1 +1	<b>20</b> <b>Ca</b> 40.08 -8-8-2 +2	<b>21</b> <b>Sc</b> 44.956 -8-9-2 +3	<b>22</b> <b>Ti</b> 47.90 -8-10-2 +2 +3 +4	<b>23</b> <b>V</b> 50.942 -8-11-2 +2 +3 +4 +5	<b>24</b> <b>Cr</b> 51.996 -8-13-1 +2 +3 +6	<b>25</b> <b>Mn</b> 54.9380 -8-13-2 +2 +3 +4 +7	<b>26</b> <b>Fe</b> 55.847 -8-14-2 +2 +3	<b>27</b> <b>Co</b> 58.9332 -8-15-2 +2 +3	<b>28</b> <b>Ni</b> 58.71 -8-16-2 +2 +3	<b>29</b> <b>Cu</b> 63.54 -8-18-1 +1 +2	<b>30</b> <b>Zn</b> 65.37 -8-18-2 +2	<b>31</b> <b>Ga</b> 69.72 -8-18-3 +3	<b>32</b> <b>Ge</b> 72.59 -8-18-4 +2 +4	<b>33</b> <b>As</b> 74.9216 -8-18-5 +3 +5 -3	<b>34</b> <b>Se</b> 78.96 -8-18-6 +4 +6 -2	<b>35</b> <b>Br</b> 79.909 -8-18-7 +1 +5 -1	<b>36</b> <b>Kr</b> 83.80 -8-18-8 0	L-M-N
<b>37</b> <b>Rb</b> 85.47 -18-8-1 +1	<b>38</b> <b>Sr</b> 87.62 -18-8-2 +2	<b>39</b> <b>Y</b> 88.905 -18-9-2 +3	<b>40</b> <b>Zr</b> 91.22 -18-10-2 +4	<b>41</b> <b>Nb</b> 92.906 -18-12-1 +3 +5	<b>42</b> <b>Mo</b> 95.94 -18-13-1 +6	<b>43</b> <b>Tc</b> (99) -18-13-2 +4 +7	<b>44</b> <b>Ru</b> 101.07 -18-15-1 +3	<b>45</b> <b>Rh</b> 102.905 -18-16-1 +3	<b>46</b> <b>Pd</b> 106.4 -18-18-0 +2 +4	<b>47</b> <b>Ag</b> 107.870 -18-18-1 +1	<b>48</b> <b>Cd</b> 112.40 -18-18-2 +2	<b>49</b> <b>In</b> 114.82 -18-18-3 +3	<b>50</b> <b>Sn</b> 118.69 -18-18-4 +2 +4	<b>51</b> <b>Sb</b> 121.75 -18-18-5 +3 +5 -3	<b>52</b> <b>Te</b> 127.60 -18-18-6 +4 +6 -2	<b>53</b> <b>I</b> 126.9044 -18-18-7 +1 +5 +7 -1	<b>54</b> <b>Xe</b> 131.30 -18-18-8 0	M-N-O
<b>55</b> <b>Cs</b> 132.905 -18-8-1 +1	<b>56</b> <b>Ba</b> 137.34 -18-8-2 +2	<b>57</b> * <b>La</b> 138.91 -18-9-2 +3	<b>72</b> <b>Hf</b> 178.49 -32-10-2 +4	<b>73</b> <b>Ta</b> 180.948 -32-11-2 +5	<b>74</b> <b>W</b> 183.85 -32-12-2 +6	<b>75</b> <b>Re</b> 186.2 -32-13-2 +4 +7	<b>76</b> <b>Os</b> 190.2 -32-14-2 +3 +4	<b>77</b> <b>Ir</b> 192.2 -32-15-2 +3	<b>78</b> <b>Pt</b> 195.09 -32-16-2 +2 +4	<b>79</b> <b>Au</b> 196.967 -32-18-1 +1 +3	<b>80</b> <b>Hg</b> 200.59 -32-18-2 +1 +2	<b>81</b> <b>Tl</b> 204.37 -32-18-3 +1 +3	<b>82</b> <b>Pb</b> 207.19 -32-18-4 +2 +4	<b>83</b> <b>Bi</b> 208.980 -32-18-5 +3 +5	<b>84</b> <b>Po</b> (210) -32-18-6 +2 +4	<b>85</b> <b>At</b> (210) -32-18-7 +1 +5	<b>86</b> <b>Rn</b> (222) -32-18-8 0	N-O-P
<b>87</b> <b>Fr</b> (223) -18-8-1 +1	<b>88</b> <b>Ra</b> (226) -18-8-2 +2	<b>89</b> ** <b>Ac</b> (227) -18-9-2 +3															O-P-Q	

*Lanthanides	<b>58</b> <b>Ce</b> 140.12 -19-9-2 +3 +4	<b>59</b> <b>Pr</b> 140.907 -20-9-2 +3	<b>60</b> <b>Nd</b> 144.24 -22-8-2 +3	<b>61</b> <b>Pm</b> (145) -23-8-2 +3	<b>62</b> <b>Sm</b> 150.35 -24-8-2 +2 +3	<b>63</b> <b>Eu</b> 151.96 -25-8-2 +2 +3	<b>64</b> <b>Gd</b> 157.25 -25-9-2 +3	<b>65</b> <b>Tb</b> 158.924 -26-9-2 +3	<b>66</b> <b>Dy</b> 162.50 -28-8-2 +3	<b>67</b> <b>Ho</b> 164.930 -29-8-2 +3	<b>68</b> <b>Er</b> 167.26 -30-8-2 +3	<b>69</b> <b>Tm</b> 168.934 -31-8-2 +3	<b>70</b> <b>Yb</b> 173.04 -32-8-2 +2 +3	<b>71</b> <b>Lu</b> 174.97 -32-9-2 +3		N-O-P
**Actinides	<b>90</b> <b>Th</b> 232.038 -19-9-2 +4	<b>91</b> <b>Pa</b> (231) -20-9-2 +5 +4	<b>92</b> <b>U</b> 238.03 -21-9-2 +3 +4 +5 +6	<b>93</b> <b>Np</b> (237) -22-9-2 +3 +4 +5 +6	<b>94</b> <b>Pu</b> (242) -23-9-2 +3 +4 +5 +6	<b>95</b> <b>Am</b> (243) -24-9-2 +3 +4 +5 +6	<b>96</b> <b>Cm</b> (247) -25-9-2 +3 +4 +5 +6	<b>97</b> <b>Bk</b> (249) -26-9-2 +3 +4	<b>98</b> <b>Cf</b> (251) -28-8-2 +3	<b>99</b> <b>Es</b> (254) -29-8-2 +3	<b>100</b> <b>Fm</b> (252) -30-8-2 +3	<b>101</b> <b>Md</b> (256) -31-8-2 +3	<b>102</b> <b>Lw</b> (254) -32-8-2 +3			O-P-Q

Numbers in parentheses are mass numbers of most stable isotope of that element.

## ATOMIC WEIGHTS

For the sake of completeness all known elements are included in the list. Several of those more recently discovered are represented only by the unstable isotopes. The value in parenthesis in the atomic weight column is, in each case, the mass number of the most stable isotope.\*\*

Name	Symbol	At. No.	International atomic weight		Valence	Name	Symbol	At. No.	International atomic weight		Valence
			1961	1959					1961	1959	
Actinium.....	Ac	89	.....	(227)	.....	Neodymium.....	Nd	60	144.24	144.27	3
Aluminum.....	Al	13	26.9815	26.98	3	Neon.....	Ne	10	20.183	20.183	0
Americium.....	Am	95	.....	(243)	3, 4, 5, 6	Neptunium.....	Np	93	.....	(237)	4, 5, 6
Antimony, stibium.....	Sb	51	121.75	121.76	3, 5	Nickel.....	Ni	28	58.71	58.71	2, 3
Argon.....	Ar	18	39.948	39.944	0	Niobium (columbium)..	Nb	41	92.906	92.91	3, 5
Arsenic.....	As	33	74.9216	74.92	3, 5	Nitrogen.....	N	7	14.0067	14.008	3, 5
Astatine.....	At	85	.....	(210)	1, 3, 5, 7	Nobelium.....	No	102	.....	(254)	.....
Barium.....	Ba	56	137.34	137.36	2	Osmium.....	Os	76	190.2	190.2	2, 3, 4, 8
Berkelium.....	Bk	97	.....	(217)	3, 4	Oxygen.....	O	8	15.9994	16.000	2
Beryllium.....	Be	4	9.0122	9.013	2	Palladium.....	Pd	46	106.4	106.4	2, 4, 6
Bismuth.....	Bi	83	208.980	208.99	3, 5	Phosphorus.....	P	15	30.9738	30.975	3, 5
Boron.....	B	5	10.811	10.82	3	Platinum.....	Pt	78	195.09	195.09	2, 4
Bromine.....	Br	35	79.909	79.916	1, 3, 5, 7	Plutonium.....	Pu	94	.....	(244)	3, 4, 5, 6
Cadmium.....	Cd	48	112.40	112.41	2	Polonium.....	Po	84	.....	(209)	.....
Calcium.....	Ca	20	40.08	40.08	2	Potassium, kalium.....	K	19	39.102	39.100	1
Californium.....	Cf	98	.....	(251)	.....	Praseodymium..	Pr	59	140.907	140.92	3
Carbon.....	C	6	12.01115	12.011	2, 4	Promethium.....	Pm	61	.....	(145)	3
Cerium.....	Ce	58	140.12	140.13	3, 4	Protactinium...	Pa	91	.....	(231)	.....
Cesium.....	Cs	55	132.905	132.91	1	Radium.....	Ra	88	.....	(226)	2
Chlorine.....	Cl	17	35.453	35.457	1, 3, 5, 7	Radon.....	Rn	86	.....	(222)	0
Chromium.....	Cr	24	51.996	52.01	2, 3, 6	Rhenium.....	Re	75	186.2	186.22	.....
Cobalt.....	Co	27	58.9332	58.94	2, 3	Rhodium.....	Rh	45	102.905	102.91	3
Columbium, see Niobium.....						Rubidium.....	Rb	37	85.47	85.48	1
Copper.....	Cu	29	63.54	63.54	1, 2	Ruthenium.....	Ru	44	101.07	101.1	3, 4, 6, 8
Curium.....	Cm	96	.....	(247)	3	Samarium.....	Sm	62	150.35	150.35	2, 3
Dysprosium.....	Dy	66	162.50	162.51	3	Scandium.....	Sc	21	44.956	44.96	3
Einsteinium.....	Es	99	.....	(254)	.....	Selenium.....	Se	34	78.96	78.96	2, 4, 6
Erbium.....	Er	68	167.26	167.27	3	Silicon.....	Si	14	28.086	28.09	4
Europium.....	Eu	63	151.96	152.0	2, 3	Silver, argentum.	Ag	47	107.870	107.873	1
Fermium.....	Fm	100	.....	(257)	.....	Sodium, natrium.	Na	11	22.9898	22.991	1
Fluorine.....	F	9	18.9984	19.00	1	Strontium.....	Sr	38	87.62	87.63	2
Francium.....	Fr	87	.....	(223)	1	Sulfur.....	S	16	32.064	32.066*	2, 4, 6
Gadolinium.....	Gd	64	157.25	157.26	3	Tantalum.....	Ta	73	180.948	180.95	5
Gallium.....	Ga	31	69.72	69.72	2, 3	Technetium.....	Tc	43	.....	(97)	6, 7
Germanium.....	Ge	32	72.59	72.60	4	Tellurium.....	Te	52	127.60	127.61	2, 4, 6
Gold, aurum....	Au	79	196.967	197.0	1, 3	Terbium.....	Tb	65	158.924	158.93	3
Hafnium.....	Hf	72	178.49	178.50	4	Thallium.....	Tl	81	204.37	204.39	1, 3
Helium.....	He	2	4.0026	4.003	0	Thorium.....	Th	90	232.038	(232)	4
Holmium.....	Ho	67	164.930	164.94	3	Thulium.....	Tm	69	168.934	168.94	3
Hydrogen.....	H	1	1.00797	1.0080	1	Tin, stannum...	Sn	50	118.69	118.70	2, 4
Indium.....	In	49	114.82	114.82	3	Titanium.....	Ti	22	47.90	47.90	3, 4
Iodine.....	I	53	126.9044	126.91	1, 3, 5, 7	Tungsten (wolfram)..	W	74	183.85	183.86	6
Iridium.....	Ir	77	192.2	192.2	3, 4	Uranium.....	U	92	238.03	238.07	4, 6
Iron, ferrum....	Fe	26	55.847	55.85	2, 3	Vanadium.....	V	23	50.942	50.95	3, 5
Krypton.....	Kr	36	83.80	83.80	0	Xenon.....	Xe	54	131.30	131.30	0
Lanthanum.....	La	57	138.91	138.92	3	Ytterbium.....	Yb	70	173.04	173.04	2, 3
Lead, plumbum..	Pb	82	207.19	207.21	2, 4	Yttrium.....	Y	39	88.905	88.91	3
Lithium.....	Li	3	6.939	6.940	1	Zinc.....	Zn	30	65.37	65.38	2
Lutetium.....	Lu	71	174.97	174.99	3	Zirconium.....	Zr	40	91.22	91.22	4
Magnesium.....	Mg	12	24.312	24.32	2						
Manganese.....	Mn	25	54.9380	54.94	2, 3, 4, 6, 7						
Mendelevium....	Md	101	.....	(256)	.....						
Mercury, hydrargyrum..	Hg	80	200.59	200.61	1, 2						
Molybdenum....	Mo	42	95.94	95.95	3, 4, 6						

\* Because of natural variations in the relative abundances of the isotopes of sulfur the atomic weight of this element has a range of  $\pm 0.003$ .

\*\* The 1959 atomic weights are based on O = 16.000 whereas those of 1961 are based on the isotope C<sup>12</sup>.